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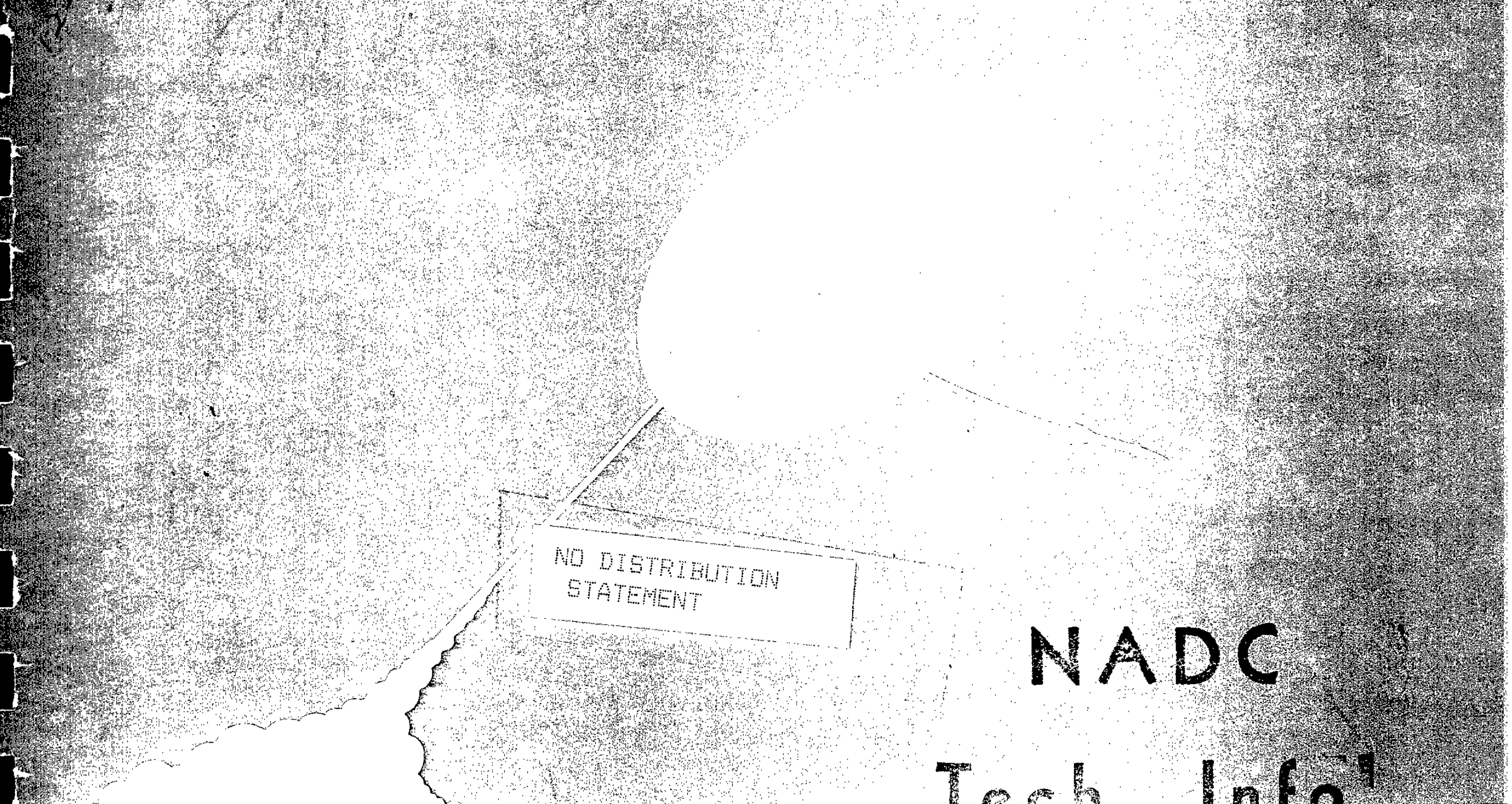

APPENDIX 2

COMPUTER PROGRAM PERFORMANCE SPECIFICATION

FINAL SOFTWARE REPORT

DATA ITEM NO. A005

INTEGRATED ELECTRONIC WARFARE SYSTEM ADVANCED DEVELOPMENT MODEL (ADM)

78 00987-3

PREPARED FOR

NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PENNSYLVANIA

CONTRACT N622[illegible]-75-C-0070

RAYTHEON
ELECTROMAGNETIC
SYSTEMS DIVISION

1 OCTOBER 1977

APPENDIX 2

COMPUTER PROGRAM PERFORMANCE SPECIFICATION (CPPS)
FINAL SOFTWARE REPORT
DATA ITEM A005

INTEGRATED ELECTRONIC WARFARE SYSTEM (IEWS)
ADVANCED DEVELOPMENT MODEL (ADM)

Contract No. N62269-75-C-0070

Prepared for:

Naval Air Development Center
Warminister, Pennsylvania

Prepared by:

RAYTHEON COMPANY
Electromagnetic Systems Division
6380 Hollister Avenue
Goleta, California 93017

1 OCTOBER 1977

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INTEGRATED ELECTRONIC WARFARE SYSTEM
(IEWS)

ADVANCED DEVELOPMENT MODEL
(ADM)

COMPUTER PROGRAM PERFORMANCE SPECIFICATION
for
System Controller Unit

Prepared for

Naval Air Development Center
Warminster, Pennsylvania

by

Raytheon Company
Electromagnetic Systems Division
Goleta, California

Under Contract
N62269-75-C-0020

1 June 1976

TABLE OF CONTENTS

TABLE OF CONTENTS (cont)

TABLE OF CONTENTS (concl)

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF TABLES (concl)

SECTION I
SCOPE

1.1 IDENTIFICATION

This document contains the computer program performance specification CPPS for the system controller (SC) unit which is part of Integrated Electronic Warfare System (IEWS). This system is described with emphasis on the relation between the SC and various units. Functional descriptions of all SC computer operations are provided which include all input, processing, and output requirements.

1.2 FUNCTIONAL SUMMARY

The SC computer program shall provide IEWS with the capability to evaluate emitter signal parameters which have been characterized by the signal sorter, assess the threat situation and initiate appropriate defensive responses. In addition, this computer program shall monitor the status of several system units and supply control signals to adapt to various operating conditions. The computer program shall also supply various data for display and instrumentation purposes.

1.2.1 EXECUTIVE

The executive shall control the real time operation of the computer program. It shall schedule the execution of overlapping programs, handle all input/output operations, monitor program execution and take corrective action as required to maintain acceptable program execution.

1.2.2 EMITTER FILE MANAGEMENT AND DATA ACQUISITION

Emitter file management shall establish, update, and delete emitter files. It shall perform this task based on data received from the signal sorter, instantaneous frequency measurement receiver, heterodyne receiver, and the AN/ALR-50 receiver. It shall call other programs as required to complete data entries in the emitter data files.

1.2.3 EMITTER CLASSIFICATION

Emitter classification shall uniquely classify the emitters associated with sorter track files. It shall perform this function by correlating the data contained within the pulse train descriptor word (PTDW) and the selected pulse descriptor words (SPDWs) associated with the specified track file against a library containing emitter descriptors. An emitter file shall be created which links multiple track files generated by a single emitter and establishes a unique classification for each active emitter file entry.

1.2.4 RESOURCE MANAGEMENT

The resource management program shall assess the response requirements of all emitters and shall allocate available resources to optimize the effectiveness of IEWS. Each emitter shall be analyzed and assigned a lethality which represents a measure of the threat that the emitter poses to the success of the mission. Emitters shall then be ranked according to lethality to establish a priority, and jamming assignments will be based upon the position of each emitter in the priority list.

1.2.5 PULSE DESCRIPTOR WORD PROCESSING PROGRAMS

The pulse descriptor word (PDW) processing programs shall contain all routines which process SPDWs and unassociated pulse descriptor words (UPDWs). The PDW sequences from specified track files shall be processed to determine scan characteristics, pulse repetition

interval (PRI) characteristics, and carrier frequency characteristics as required to support other programs.

1.2.6 CONTROL AND DISPLAY

The control and display program shall contain all routines required to retrieve and format data for presentation on the display and control unit. This program shall be interactive with the operator by responding to display data requests, and implementing operator generated technique and priority assignment overrides.

1.2.7 SYSTEM MANAGEMENT

The system management program shall contain a number of routines which respond to overflow messages generated by various units comprising IEWS. These programs, in general, shall adapt system thresholds to keep sensitive units from being overloaded.

1.2.8 DEVICE INTERFACE

Program modules shall be provided which establish a link between the signal processing programs and the input/output (I/O) programs which control the transfer of data between the system controller and external units. These program modules shall be organized by I/O functions and shall retrieve and format data for all I/O operations.

1.2.9 NONOPERATIONAL SUPPORT PROGRAMS

This group includes all programs which normally would not be executed as part of the operational signal processing but are required for system operation. At the present time, this group is limited to the power up and program load sequence. This module shall load all memory within IEWS, including the signal sorter and technique generator, with programs from a magnetic tape cassette unit.

1.2.10 BUILT-IN TEST

A built-in test program shall be executed in response to a request from the system operator. This test shall result in the generation of special synthetic emitters within the system and shall present the resulting track files to the system operator for evaluation. This program shall not interfere with normal system operation except for the display data.

SECTION II

APPLICABLE DOCUMENTS

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

AETD-XAV-1000	Experimental and Developmental Specification IEWS (Integrated Electronic Warfare System)
AR-106	Commonality of Digital Computer Hardware and Programming Languages within a Weapon System, Requirements for
WS-8506	Digital Computer Program Documentations, Requirements for

RAYTHEON SPECIFICATIONS

574773	Software Product Assurance Plan
Volume 7	Raytheon Engineering Standards Manual – Computer Programs
53959-GT-0301 Rev B	System Controller Unit Hardware Development Specification (ADM) IEWS
	System Controller Software Functional Requirements

SECTION III
REQUIREMENTS

This section defines and specifies all functional, operational, and performance requirements. It also includes all design constraints and standards necessary to ensure proper development and maintenance of the SC computer program.

3.1 INTRODUCTION

The purpose of IEWS is to counter hostile, radar-associated weapon systems operating in the 1985 time frame by use of an advanced system design. This system is designed to facilitate demonstration of the concept in laboratory simulations and in airborne flight tests.

3.1.1 GENERAL DESCRIPTION

The IEWS comprises a number of units which are integrated to form an advanced electronic warfare system. These units include receivers that detect, and encode in a digital format, all pulse and CW signals within the operating frequency range. The encoded information is processed digitally to separate the signals into groups corresponding to individual emitters in the environment. Each emitter shall be identified and analyzed to determine the level of threat it poses to the aircraft. Defensive countermeasures shall be initiated against all emitters which are identified as threats.

The computer program specified herein includes the requirements for emitter identification, response assessment, and general system management. It also includes requirements for generation of data for the display and control unit.

3.1.2 PERIPHERAL EQUIPMENT IDENTIFICATION

When configured in the operational state, the SC interfaces with the following units:

1) multibeam receiver,
2) heterodyne receiver,
3) instantaneous frequency measurement receiver,
4) parameter encoder,
5) signal sorter,
6) emitter tracker,
7) technique generator,
8) display and control,
9) program tape cassette,
10) instrumentation tape,
11) external device 1 (HARM),
12) external device 2 (ALE-39),
13) external device 3 (MAWS), and
14) external device 4 (EO).

When configured for maintenance, the SC also interfaces with the following maintenance control panels and special test equipment (STE):

1) response CPU maintenance control panel,
2) classification CPU maintenance control panel,
3) analysis CPU maintenance control panel, and
4) STE.

All other support peripheral equipments shall be accessed through the STE interface.

3.1.3 INTERFACE IDENTIFICATION

The system controller interfaces with the following computer systems:

1) signal sorter,
2) technique generator, and
3) STE.

3.2 FUNCTIONAL DESCRIPTION

The major functions of the SC computer program are described in this section. Also described are the functional relationships of the resulting computer program with interfacing equipment and with other computer programs.

3.2.1 EQUIPMENT DESCRIPTION

A block diagram of the operationally configured IEWS is shown in figure 1. The primary data functional flow between the various units is separated from the command and control path. Data flow in general proceeds along two paths. The first consists of a flow from the receiver through the parameter encoder and the signal sorter to the system controller for analysis and response assessment. The second proceeds from the receiver and parameter encoder and signal sorter to the emitter tracker, techniques generator, and multibeam transmitter to generate an active countermeasure response. The command and control extends from the SC to all indicated units. The system operation is normally automatic; however, the operator can exercise certain override functions through the display and control unit to the system controller.

3.2.1.1 Multibeam Receiver

The multibeam receiver (MBR) provides simultaneous detection and spatial separation of all threat emitters within the frequency range and over a 360 degree field of view. The MBR provides RF signal energy for the repeater channel to the multibeam transmitter. It also provides video signals to the heterodyne receiver and to the parameter encoder for CW and pulse signal processing, respectively. The MBR has controllable RF attenuation to raise the system threshold and to decrease system sensitivity. The SC software shall use the sensitivity control to adapt to the environment by decreasing the number of emitters entering the system when the processing system becomes overloaded. The SC software shall be capable of raising the system threshold by 40 dB in 5 dB steps.

3.2.1.2 Instantaneous Frequency Measurement Receiver

The instantaneous frequency measurement receiver (IFMR) measures the frequency of pulse signals and detects CW signals. The primary output of the IFMR goes to the parameter encoder and consists of a digitally encoded frequency measurement and a multifrequency indication. The IFMR also provides a digital frequency measurement to the heterodyne

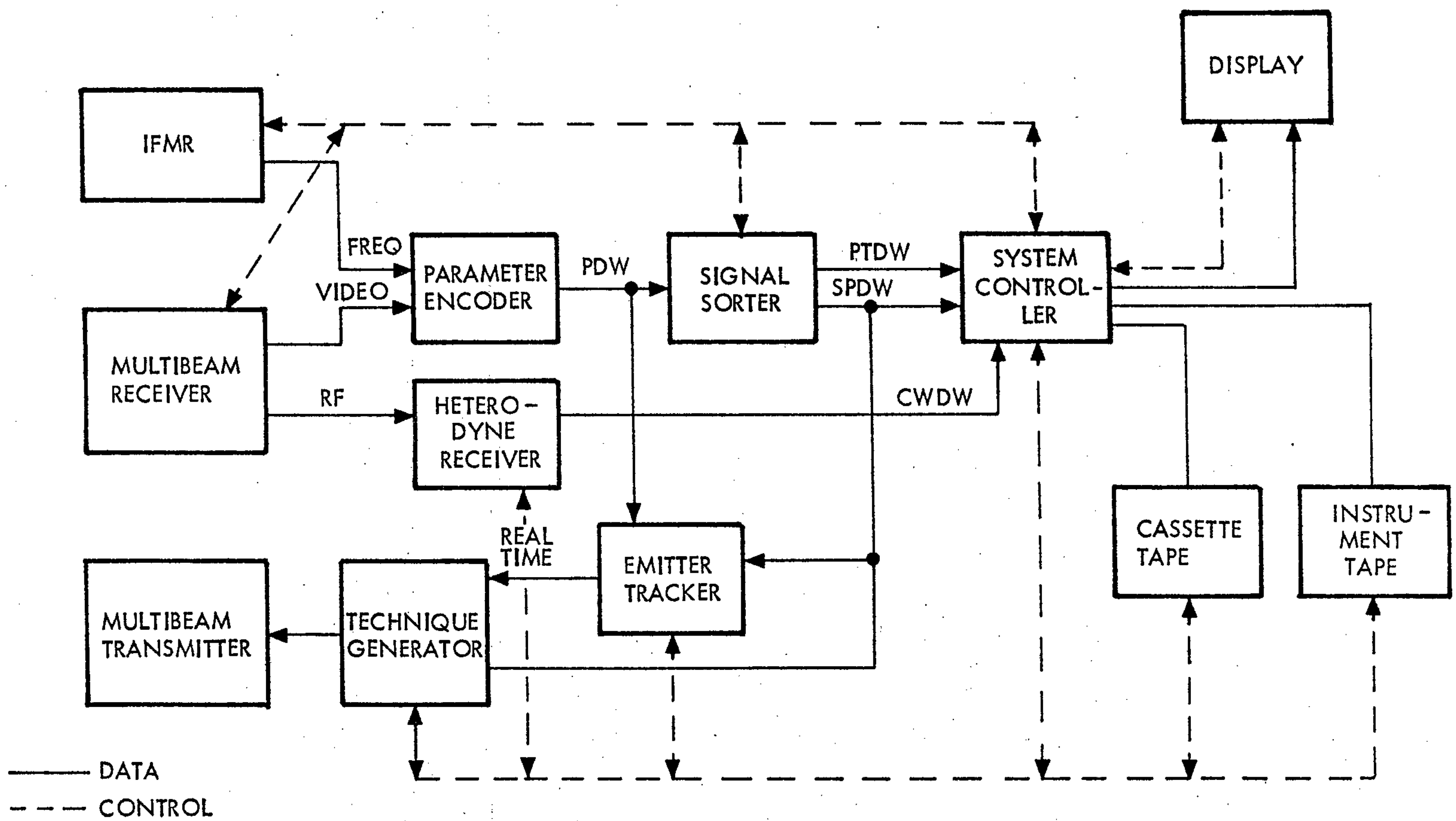

Figure 1. IEWS System Block Diagram

receiver. A secondary IFMR output to the SC provides an indication of the presence of one or more CW signals. There shall be no requirement for the SC software to control the IFMR. The output of the IFMR to the SC shall be used to initiate the measurement of a CW signal by the heterodyne receiver. The CW indication from the IFMR is sent to the SC whenever a signal exceeds the CW threshold for at least 100 μs and remains for the duration of the signal. A separate CW indication is sent for each 2 GHz subband. The presence of the CW indication requies the SC software to respond to an interrupt and shall initiate a search for the CW signal in the indicated subband.

3.2.1.3 Heterodyne Receiver

The heterodyne receiver (HR) provides the capability to measure amplitude, angle-of-arrival, and frequency for CW signals. The HR receives RF signals from the multibeam receiver. These signals are used to obtain amplitude and angle-of-arrival data and, when required, CW frequency shall be obtained by measurement of the HR local oscillator using the IFM receiver. The HR responds to control inputs from the SC for dwell time, frequency limits, and enable/disable. Hence, the HR will search variable frequency bands at variable rates. The HR shall be used by the SC software to acquire and track CW signals. The HR provides resolution and range as listed in table 1.

Table 1. Resolution and Range for HR

Parameter	Resolution	Range
amplitude	1.6 dB	48 dB
angle-of-arrival	11°	180°
frequency	1.25 MHz	normal range

To accomplish measurement of CW signals, the SC software shall control operation of the HR and shall accept measurement data from the HR.

3.2.1.4 Parameter Encoder

3.2.1.4.1 Purpose

The parameter encoder (PE) processes pulse signals detected by the MBR by measuring and encoding the angle-of-arrival, time-of-arrival, amplitude, and pulse width. The PE correlates this information with frequency data from the IFMR and assembles the data as PDWs for further processing by the signal sorter and the SC. The PE receives real-time signals from the AN/ALR-50 receiver and correlates them with signals from the MBR and IFMR. The PE tags PDWs that correlate with the AN/ALR-50 receiver video, and also provides strobes, video signals, angle-of-arrival data, and system clock timing signals as real-time inputs for ECM techniques. The PE and the emitter tracker are housed in the same physical unit.

3.2.1.4.2 Controls

The SC software shall have the capability to send angle correction information, a threshold setting, and a long pulse mode control signal to the PE.

3.2.1.4.2.1 Angle Correction. The angle correction shall be the heading of the aircraft relative to a fixed ground heading. This information is used by the PE to convert angle-of-arrival to azimuth. Angle correction is used to stabilize the azimuth value in the processing system so that all emitter tracks will not change angle as the aircraft executes azimuth maneuvers. The angle correction will have a resolution of 1.4 degrees and a range of 360 degrees. Periodically, the SC software shall obtain the angle correction value from the intertial navigation system and shall update the PE with the current value.

3.2.1.4.2.2 Threshold. The threshold control in the PE shall be used by the SC software to adapt to the environment by decreasing the number of emitters entering the system when the processing becomes overloaded. The threshold has a resolution of 1.6 dB and a range of 51 dB. The SC software shall control the setting of the PE threshold.

3.2.1.4.2.3 Long Pulse Mode. The long pulse mode (LPM) control will be used to control the method of measurement for pulse widths greater than 4 μs. In the first mode, the pulse width is encoded as being greater than 3.6 μs. In the second mode, the PE generates a series of PDWs that are encoded at 4 μs increments for the duration of the pulse or for 16 PDWs, whichever occurs first. The LPM control requires the SC software to specify the mode of operation to the PE.

3.2.1.5 Signal Sorter

3.2.1.5.1 Purpose

The signal sorter (SS) accepts and processes PDWs from the PE. The SS sorts the incoming PDWs on the basis of azimuth, frequency, PRI, and pulse width. The SS establishes and maintains track files on the sorted pulse trains and informs the SC of changes in track file status. It also updates the track file parameters. Upon request, the SS outputs PDWs to other units in the system.

3.2.1.5.2 Controls

The SS responds to control signals that modify its operation in several ways. The control signals can be divided into the following categories:

1) processor controls,
2) memory modification,
3) parameter controls,
4) file controls,
5) auxiliary bus controls, and
6) test controls.

3.2.1.5.2.1 Processor Controls. The processor controls determine the operating modes of the two microprocessors contained in the SS. The controls consist of initialization, start, stop, and pause commands.

3.2.1.5.2.2 Memory Modification. The SC software shall have the capability to read and write memory locations in the SS. This capability shall be used to load programs, to check memory contents, to modify program constants, and to dump blocks of memory.

3.2.1.5.2.3 Parameter Controls. The SC software shall have the capability to modify the tracking parameters of the SS. Modification of these parameters affects the tracking characteristics of the SS. The parameters include frequency, PRI, pulse width, parameter quality bits, and threshold values.

3.2.1.5.2.4 File Controls. The SC software shall have the capability to control the throttle and track files in the SS. The controls shall include the ability to create and delete files and to modify the update rates for the files.

3.2.1.5.2.5 Auxiliary Bus Controls. The SC software shall have the capability to control the PDW traffic on the auxiliary bus. The SC is able to start and stop PDW transmission. The SC software shall specify which PDWs are to be transmitted and the destination(s) for the PDWs.

3.2.1.5.2.6 Test Controls. The SC software shall have the capability to output synthetic PDWs and built-in test requests to test the operation of the SS.

3.2.1.5.3 Use In System

The SS is used in IEWS to sort the received PDWs into pulse trains which are tracked in the sorter track file. The SS maintains these files and provides update status to the SC. The SS reduces the data rate so that the SC is able to perform the more sophisticated data processing involved in emitter classification and resource management.

3.2.1.5.4 Requirements

The SS accepts PDWs from the PE at an average rate of 100,000 PDWs per second and at burst rates of up to 1,000,000 PDWs per second. The SS establishes track files on the basis of angle/frequency agreements within ±1 cell in azimuth and ±2.5 MHz in frequency. The tracking parameters are azimuth, frequency, PRI, and pulse width with the ranges listed in table 2.

Table 2. Range for SS Tracking Parameters

Parameter	Range
azimuth	±1 cell
frequency	5%
PRI	10%
pulse width	±1 cell

3.2.1.6 System Controller

The SC is the central processing and control unit in IEWS. The SC contains the computer programs specified by this document. The SC consists of three microprocessors designated as the classification processor, the analysis processor, and the resource management processor. The classification processor has the sensory interfaces to the SS, the IFMR, and the HR. The analysis processor interfaces with the auxiliary bus from the SS. The resource management processor interfaces with the PE, the emitter tracker, the techniques generator, the display and control, and the STE. All three processors within the SC have internal interfaces with one another.

3.2.1.7 Emitter Tracker

The emitter tracker (ET) provides trigger strobes and anticipatory gates to the techniques generator to support the real-time jamming of up to 16 emitters. Upon command from the SC, the ET accepts inputs from the PE and the SS to perform a real-time tracking function for azimuth or frequency. Trackers are capable of being assigned to a specific jamming channel. The ET accepts channel assignments from the SC as well as tracking parameters

such as gate widths, flywheeling, stagger level, and PRI. The SC software shall have the capability to manage channel assignments and to specify channel tracking parameters to the ET. The ET contains eight pulse train separator (PTS) trackers and eight signal sorter trackers (SSTs). The PTS circuits are capable of tracking PRIs from 51.3 μs to 6.6 ms in an environment of up to 50,000 pulses per second. The SSTs are capable of tracking PRIs from 64 μs to 8 ms in an environment of up to 100,000 pulses per second.

3.2.1.8 Techniques Generator

The techniques generator (TG) accepts real-time and nonreal-time commands to generate ECM techniques. The TG generates the technique waveforms and steers them to the designated transmitter beam port. The SC software shall have the capability to specify technique number, frequency, tracker channel number, and special generator number to the TG. To manage the TG, the SC software shall perform response assessment and resource management functions to determine technique number and to allocate resources. The TG provides repeater and transponder jamming modulation signals selectable from up to 24 waveform generators which can modulate the received signal or one of four transponder sources.

3.2.1.9 Multibeam Transmitter

The multibeam transmitter (MBT) provides high ERP pulse and CW ECM transmissions to selected threats. Simultaneous response to multiple threats is provided. There is no control interface to the MBT directly. Switching controls in the TG select the correct beamport to direct RF energy in the proper direction. The MBT antenna coverage is 120 degrees with 13 azimuth beams and an elevation beamwidth of 55 degrees.

3.2.1.10 Display and Control

The display and control (D/C) provides the operator with a display of emitter characteristics and angle-of-arrival. It also provides the operator with the capability to control the parameter display, the jamming technique, the jamming priority and the built-in test function. The D/C contains an alphanumeric display field and a polar display. The alphanumeric field displays either a listing of emitters with their prime data or detailed parameters on a single hooked emitter. The polar display presents a symbolic representation of selected threat emitters on the periphery of the circular CRT. Emitters can be displayed as detected at their angle-of-arrival or as an expansion of multiple emitters in a single angle cell. A cursor control is provided so that the parameters for an emitter selected from the polar display will be presented on the alphanumeric display. The resolution of the polar display is 5.6 degrees. To service the D/C, the SC software shall update the display periodically and shall respond to changes in switch positions.

3.2.1.11 Special Test Equipment

The STE has interfaces at points in the system where data is transferred in order to monitor data transfer and to be able to inject or receive data for unit test or system test purposes. In relation to the SC, the STE will be in parallel on the auxiliary bus, and on the parallel I/O port at the resource management processor. On the auxiliary bus, the STE can either send or receive PDWs. On the resource management processor I/O port, the STE is able to receive data for every address accessed at that port and is able to simulate the operation of the SC or any other device connected to that port. During normal system operation, the STE assumes a passive mode of operation as a listen only device. The STE contains a tape cassette to be used for program loading and has memory addresses allocated to instrumentation data storage. The SC software shall have the capability to perform a program loading function for the STE program input and shall have data extraction software to provide outputs for instrumentation purposes.

3.2.1.12 HARM (Growth)

The HARM is an external system to IEWS with an interface to the SC. The SC software shall continuously hand off the three highest priority threats in the forward quadrant to HARM. Provision shall be made for the operator to designate specific lower priority threats for missile attack. The SC software shall output signals to the HARM which will tune the missile, and control the mode of operation. Control commands shall permit an autonomous operation of the weapon control module in HARM in a high sensitivity mode using the missile seeker as a sensor. The SC software shall also monitor the status signals available from the HARM.

3.2.1.13 Electro-Optical System (Growth)

The electro-optical (EO) system is a system that is external to IEWS with an interface to the SC. The EO system monitors the light spectrum. Upon detection of a threat, the EO system measures signal parameters and identifies the threat. The threat data is transferred directly to the SC. If IRCM is warranted, the SC sends control signals to the IRCM equipment to initiate countermeasures. The EO system is used to expand the radiation spectrum over which sensor data can be obtained and countermeasures deployed. The EO system places requirements on the SC software to accept, process, and correlate EO data and to manage resources to use the IRCM to enhance the overall system response.

3.2.1.14 AN/ALE-39 (Growth)

The AN/ALE-39 is an external system to IEWS with an interface to the SC. The AN/ALE-39 system provides the capability to dispense chaff, flares, and jammers. The SC software shall generate launch commands to the AN/ALE-39 to create patterns based upon the threats to be countered. The SC software shall maintain a record of the expendables available and shall manage the dispensing of resources.

3.2.1.15 Multibeam Active Warning System (Growth)

The Multibeam Active Warning System (MAWS) is an external system to IEWS with an interface to the SC. The MAWS provides an active radar capability using the multibeam transmitter to detect the presence of passive threats. The SC software shall have the capability to accept inputs from MAWS and to provide appropriate alerts to the pilot so that he can take evasive action.

3.2.2 INPUT/OUTPUT CHANNEL UTILIZATION

The SC software program shall have the capability to service the interfaces listed in table 3 by receiving and sending data at the rates and in the quantities shown.

3.2.3 COMPUTER INTERFACE BLOCK DIAGRAM

The computer interface block diagram is shown in figure 2. The diagram shows all SC/equipment interfaces in IEWS. Three parallel bus systems operate between the SC and other equipment. They are:

1) classification bus,
2) auxiliary bus, and
3) resource management bus.

The classification bus handles message traffic between the SC and the SS. The auxiliary bus distributes PDWs throughout the system. The resource management bus interfaces to many of the other units in the system. Low data rate interfaces comprise six serial data busses. The address allocation to each unit or processor in the system is shown in figure 2.

Table 3. I/O Channel Utilization

Hexadecimal Channel Number *	Interface Characteristics	Channel Type	Word Size Bits	Connected Equipment	Number of Input Words	Number of Output Words	Transfer Rate
RMP: C000-CFFF	Parallel 4K Locations	Shared Memory	16	Techniques Generator	0	2	Aperiodic
RMP: D000-EFFF	Parallel 8K Locations	Shared Memory	16	Special Test Equipment	Variable	Variable	Aperiodic
RMP: F000-F1FF	Parallel 512 Locations	Normal	16	Display and Control	2	4	10 Hz
RMP: F200-F3FF	Parallel 512 Locations	Normal	16	Parameter Encoder and Emitter Tracker	0 3	2 3	Aperiodic
RMP: F500-F5FF	Parallel 256 Locations	Normal	16	MAWS	TBD	TBD	TBD
RMP: FC00-FC0F	Serial (4)	Parallel/ Serial Converter	8	MBR, HARM, EO, AN/ALE-39	Variable	Variable	Aperiodic
CP: C000-C7FF	Parallel 2K Locations	Shared Memory	16	Signal Sorter	Variable	Variable	Aperiodic
CP: FC00-FC07	Serial (2)	Parallel/ Serial Converter	8	IFMR HR	1 2	0 3	Aperiodic
AP: C000-C3FF	Parallel 1K Locations	Shared Memory	16	Auxiliary Bus Buffer	64	0	Aperiodic
AP: FCC0-FCFF	Parallel 64 Locations	Normal	16	Auxiliary Bus Interface	17	37	Aperiodic

* RMP = resource management processor
CP = classification processor
AP = analysis processor

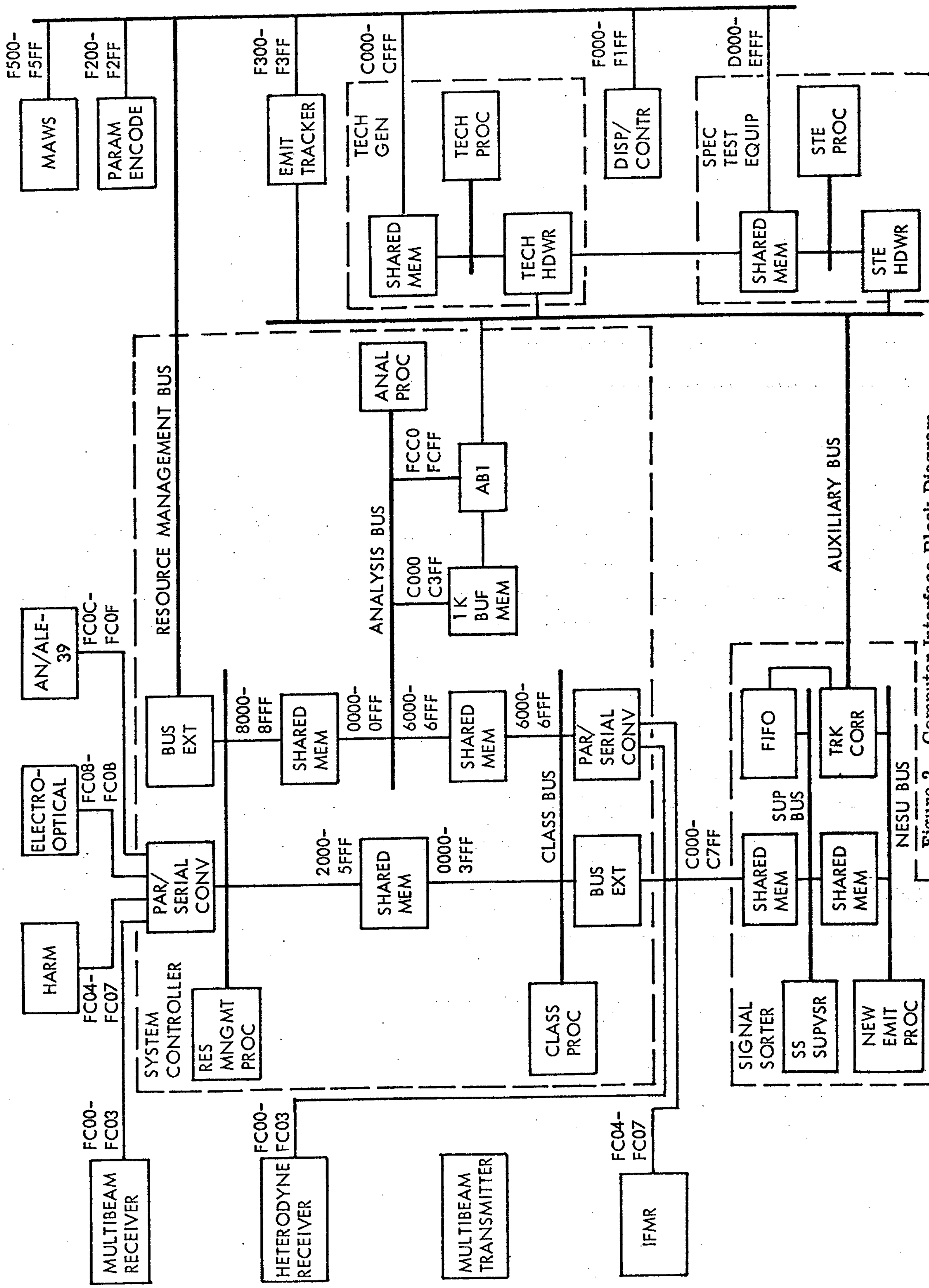

Figure 2. Computer Interface Block Diagram

3.2.4 PROGRAM INTERFACES

The SC program interfaces with computer programs in the SS, TG, and STE. Communications take place between computer systems by using memory shared by the two computers as a "mail box" to send and receive messages.

3.2.4.1 Signal Sorter Messages

Messages shall be passed between the SC and the SS supervisor using buffer locations in their shared two-port RAM. Messages transmitted across this interface shall be for controlling SS performance, transmission of new emitter and track file update information, monitor and control of the input buffer throttling function, and performance analysis.

3.2.4.1.1 SC to SS Messages

Messages to the SS supervisor originate in the SC and shall be in the form of one to sixteen 16-bit words. Two buffers, a high priority and a low priority, are used for such transmissions. The high priority buffer shall utilize the hardware interrupt feature of the two-port RAMs to notify the supervisor of a pending message. Priority messages from the SC shall have the third highest interrupt priority. The highest priority is reserved for power fail and a watchdog timer. The SC shall write into RAM location C010 to initiate an interrupt of the supervisor. Reading RAM location C010 clears the interrupt. Only one message of a given priority is accepted by the supervisor. No action shall be taken on another message of the same priority until the first message has been processed. The act of clearing the valid message flag signifies to the sender that the message has been processed. Thus, in no case shall the message buffer valid flag for a given priority be cleared by the supervisor until it has processed the first message in the sequence.

The high priority buffer locations shall consist of:

Memory Location	Function
C010	interrupt generator
TBD (1 word)	buffer status flag and word count
TBD (1 word)	command
TBD to TBD (14 words)	message buffer

The low priority messages from the SC to the supervisor shall be indicated through the use of a status word associated with the buffer area. If the buffer flag (MSB of the word) is zero, the buffer is assumed to be empty. If the buffer flag is set, the buffer is assumed to contain a valid message. The supervisor shall clear the low priority flag upon completion of message processing.

The low priority message buffer shall consist of:

Memory Location	Function
TBD (1 word)	buffer status flag and word count
TBD (1 word)	command
TBD to TBD (14 words)	message buffer

The SC to SS messages shall be of the following types:

1) processor controls – start, stop, pause, initialize,
2) memory modification – read and write, load programs,
3) parameter controls – emitter and tracking parameters,
4) file controls – create, delete, modify,
5) auxiliary bus controls – start, stop, type PDWs, destination, and
6) test controls – synthetic PDW, bit request.

The estimated data rate from the SC to the SS is 200 sixteen-bit words/second.

3.2.4.1.2 SS to SC Messages

As in the case of SC to SS messages, SS to SC messages shall be passed through a similar set of high and low priority buffers. Location C011 in the RAM shall be used as the high priority interrupt address for passing messages to the SC. The high priority buffer shall consist of:

Memory Location	Function
C011	interrupt generator
TBD (1 word)	buffer status flag and word count
TBD (1 word)	command
TBD to TBD (14 words)	message

The low priority messages to the SC from the SS shall be indicated through the use of a status word associated with the buffer area. If the buffer flag (MSB of the word) is zero, the buffer is assumed to be empty. If the buffer flag is set, the buffer is assumed to contain a message comprised of the number of words specified by the eight least significant bits of the flag word. The SC shall clear the flag word after accepting the message from the SS. The mean time to message acceptance shall be one millisecond. The low priority message buffer shall consist of:

Memory Location	Function
TBD (1 word)	buffer status flag and word count
TBD (1 word)	command
TBD to TBD (14 words)	message

The sorter to SC messages shall be of the following types:

1) processor status – error conditions,
2) memory contents – memory dumps,
3) emitter data – parameters, update and new emitter, guidance signal data,
4) file status – inactive files, created files,
5) overflow – files and buffers, and
6) test request – bit.

The estimated data rate from the SS to the SC is 550 words/second.

3.2.4.2 Techniques Generator

A shared memory between the TG and the SC shall be loaded at initialization time with program instructions and data. Either part of the shared memory or separate, addressable registers shall be used to send TG/SC messages back and forth. Messages transmitted across this interface shall be for controlling jamming by the TG and for reporting TG status to the SC.

3.2.4.2.1 SC to TG Messages

Messages transmitted to the TG shall originate in the SC and shall be single 16-bit word messages sent to specified address locations in the TG. A status word shall be used to indicate to the SC that it may write a new message to a specific address. The TG indicates a write enable condition only after it has loaded the previous message. The SC shall write a new message only if write is enabled.

The SC to TG messages shall be of the following types:

1) processor controls – start, stop, pause, initialize,
2) memory modification – read, write, program load,
3) parameter controls – change generator parameters, and
4) technique assignment – start, stop, frequency channel.

The estimated data rate from the SC to the TG is 30 sixteen-bit words/second.

3.2.4.2.2 TG to SC Messages

The message status word shall be read only (no write) by the SC. The SC shall use the information in the status word to determine if it is permissible to send a message to the TG. The estimated data rate from the TG to the SC is 10 sixteen-bit words/second.

3.2.4.3 Special Test Equipment

A shared memory between the STE and the SC is used for communications between the two units. The purpose of the interface is to load programs into the SC and to dump instrumentation data to the STE. Either part of the shared memory or separate, addressable registers shall be used to control the operation of a cassette tape unit in the STE. The SC programs shall be resident on the tapes.

3.2.4.3.1 SC to STE Messages

The message transmitted from the SC to the STE shall contain control words and instrumentation data. The SC shall notify the STE that instrumentation data has been placed in the shared memory. A control word shall contain the memory locations of the data and an enable to the STE to read the data. Control words are also used to control the operation of the cassette tape unit. The tape control consists of start, stop, rewind and file dump commands. The estimated data rate from the SC to the STE is 200 sixteen-bit words/second.

3.2.4.3.2 STE to SC Messages

Messages from the STE to the SC shall consist of status words which indicate the availability of memory locations in which to store instrumentation data. Status words shall be read only (no write) by the SC. Other status words shall also indicate the current status of the cassette tape unit. The SC shall command the tape unit only when it is ready. The estimated data rate from the STE to the SC is 20 sixteen-bit words/second.

3.2.5 FUNCTIONAL DESCRIPTION

This section describes each function that shall be implemented by SC computer program.

3.2.5.1 Executive

The executive module serves as a real-time management program which shall control the execution of the remaining functional programs contained within the SC. It shall handle all I/O operations, schedule the execution of operational programs, and provide for communication between program modules and between processors. Identical executive modules shall be resident in each of the system controller processors and shall be partitioned into the following subfunctions:

1) interrupt and polling service,
2) service and task schedule queue maintenance,
3) time monitoring, and
4) intercomputer communications.

3.2.5.1.1 Interrupt and Polling Services Subfunction

The interrupt and polling services subfunction shall respond to all external hardware interrupts. This subfunction shall perform all immediate services required and enter requests for other services on the foreground queue. Upon completion, the interrupt shall be cleared and control returned to the tasks interrupted. Polling shall be performed at the completion of an execution block. Information obtained from polling shall be entered into service queues as required.

3.2.5.1.2 Service and Task Schedule Queue Maintenance Subfunction

This subfunction shall maintain the queues required for orderly ECM processing and data movement. The queue structures shall be designed to provide for a scheduling algorithm. Each entry in a queue shall contain data required to maintain a current machine state, service a requested task, and shall also contain a parameter pointer. This subfunction shall maintain separate queues for system management (foreground) and ECM processing (background).

3.2.5.1.3 Time Monitoring Service Subfunction

The time monitoring service subfunction shall maintain system time and shall monitor the operation of ECM processing in a real-time mode. Setting of time limitations on execution of processes and selection of intervals for device polling shall be the responsibility of this subfunction.

3.2.5.1.4 Inter-Computer Communication Subfunction

This subfunction shall be responsible for the maintenance of processor shared memories. The passing of data and requests for data between two or more processors shall be monitored and serviced by this routine.

3.2.5.2 Emitter File Management and Data Acquisition

This portion of the computer program shall contain those routines required to accept data from various receivers, establish track files for individual emitters present in the environment, and validate the data received from and the performance of the source device. Input data is received from three devices, the SS, the IFMR and the HR. The SS provides data

on pulse signals and signals detected by the AN/ALR-50 receiver. The IFMR and HR supply data on CW signals. The processing contained in this program shall be partitioned into three major subfunctions as shown in figure 3. These program subfunctions shall be: (1) pulse signal acquisition, (2) CW signal acquisition, and (3) AN/ALR-50 signal acquisition.

3.2.5.2.1 Pulse Signals

Pulse signals shall be obtained through the SS unit. The sorter shall detect and track such signals and supply a PTDW for each track file established. The pulse signal acquisition program shall accept the PTDW and shall enter relevant portions into an emitter track file (ETF). This program shall then execute a number of tests to verify the validity of the track established by the SS. If errors are detected, the program shall modify existing ETF data and reprogram the sorter to modify its track parameters or to reacquire the signal. When track files are verified, all signals will be forwarded to the classification program for reidentification.

3.2.5.2.2 CW Signals

CW signals shall be acquired using the IFMR and the HR. The IFMR shall send CW alert signals whenever CW signals have been detected in any of its operating 2 GHz subbands. These alerts shall be used to generate a search band of frequencies for signal acquisition. These bands plus the currently tracked CW signal frequencies shall be used by the heterodyne tune program to instruct the HR tune circuits. The HR shall return a continuous wave data word (CWDW) for each CW signal detected in the band searched. This data shall be used to establish, update and delete CW track files as part of the CW track file maintenance program.

3.2.5.2.3 AN/ALR-50 Signal Acquisition

Signals detected by the AN/ALR-50 receiver shall be acquired through the SS as missile activity (MA) alert messages. The AN/ALR-50 signal acquisition program shall establish a synthetic track file when such alerts are received and shall generate all data required to process the signal as a normal pulse signal. This program shall then forward the track file to the classification program for identification.

3.2.5.3 Emitter Classification

Each emitter in the environment shall be classified by analyzing the data contents of associated emitter track files. This classification shall be accomplished by forming an emitter descriptor based on a subset of emitter track files which characterizes a single emitter in the environment. This descriptor shall then be compared against a set of discriminants stored in an emitter library to detect a match condition. A library entry shall be made for each emitter type and mode that the IEWS is programmed to recognize. The same basic procedure shall be used for all file types, pulse, CW and AN/ALR-50 signals, and for new emitters as well as updates on previously identified emitters. Provisions will be made to shorten the cycle by bypassing certain operations which may be unnecessary for certain entries into the classification program. The basic overall classification sequence is shown in figure 4.

3.2.5.3.1 Pulse Signals

Pulse signals shall be subjected to the most comprehensive classification program consisting of the sequence shown in figure 4. A level 1 search program shall be used to generate a candidate list based upon the PTDW parameters, frequency, PRI, and pulse width. If a list is generated, a second set of parameters derived from a SPDW analysis, scan type and period, shall be used to reduce the list using a level 2 search. If either search sequence produces no candidates, the emitter shall be classified as an emitter of no concern (NOFA) and no further processing shall be implemented. If candidates are generated, the emitter track file shall be subjected to a link analysis which shall attempt to associate multiple track files which may have

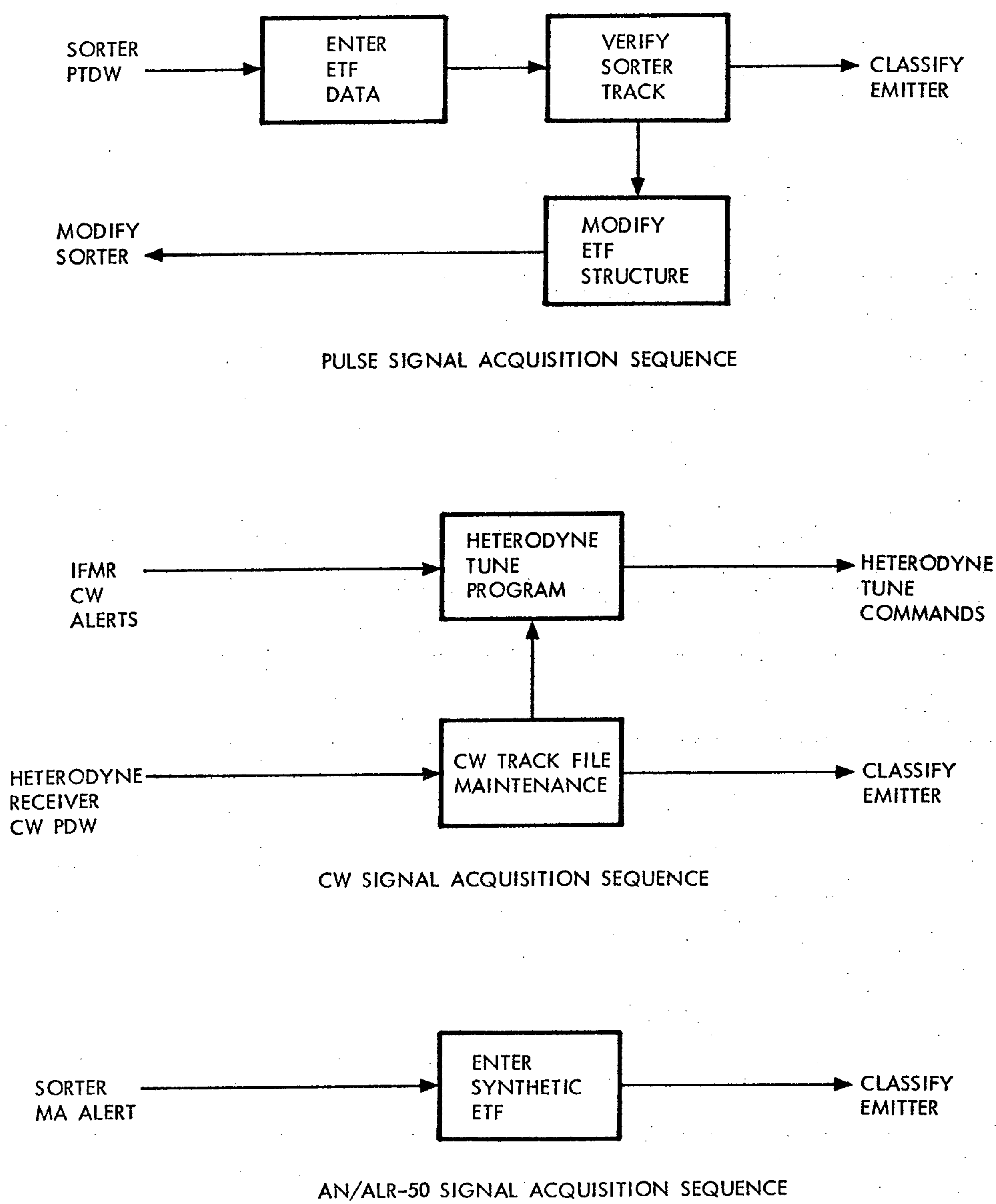

Figure 3. Signal Acquisition and File Management Sequence

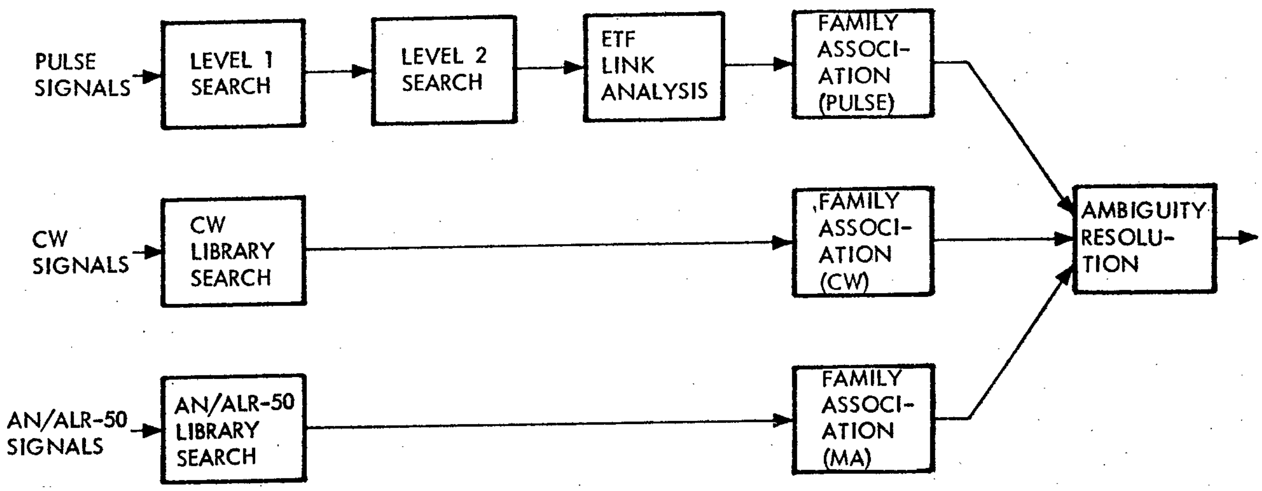

Figure 4. Classification Sequence

been generated by a single emitter. This link operation shall be based solely upon the characteristics of the signals associated with each of the track files. Following the link analysis, a family association program shall analyze the candidate lists of all emitter track files which may have been linked together. The candidate list may be further thinned if such associations can be detected. The candidate list is then sent to an ambiguity resolution program which shall select one of the candidates based on prestored weighting factors contained in the emitter library. All track files which contain classification codes other than NOFA shall be forwarded to the resource management program for further processing.

3.2.5.3.2 CW Signals

CW signals shall be classified using only a library search, a family association, and the ambiguity resolution modules. The search routine shall use the descriptors provided by the CW acquisition program and shall limit its search to the CW portion of the library. Family associations shall be based upon a unique CW requirement and essentially shall merge the link analysis and family association techniques used for pulse signals.

3.2.5.3.3 AN/ALR-50 Signals

Missile guidance signals detected through the AN/ALR-50 receiver shall be classified using a library search, a family association, and the ambiguity resolution modules. The library search program shall use the parameters provided by the AN/ALR-50 signal acquisition program and shall limit its search to the AN/ALR-50 portion of the emitter library. It shall also use a modified family association designed for missile guidance signals, followed by the ambiguity resolution program to select one entry if multiple candidates exist.

3.2.5.4 Resource Management

Resource management shall contain those routines which assess the response requirements for each emitter and manage available resources to optimize the overall IEWS performance to counter hostile emitters. This program shall be executed for all emitters which have been classified with some identification other than NOFA. (See paragraph 3.2.5.3 signal classification.) Responses made against specific emitters shall depend upon response codes included as part of each entry in the emitter library and upon available resources. The program sequence is shown in figure 5.

3.2.5.4.1 Priority Assessment

Each emitter whose classification is other than NOFA shall be evaluated to determine a priority ranking. This shall be accomplished by computing a lethality based upon classification and certain signal parameters which indicate a measure of the level of threat that the emitter presents to the aircraft. Emitters whose lethality exceed a threshold shall be ordered according to lethality to establish a list of relative priority.

3.2.5.4.2 Technique Options

Each emitter entered into the priority list shall be analyzed to determine the technique options available for assignment. This program shall generate up to three technique codes based on the response code contained in the emitter library and upon certain signal parameters.

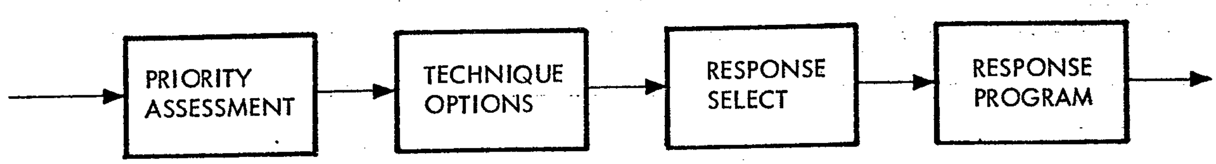

Figure 5. Resource Management Sequence

3.2.5.4.3 Response Selection

Each emitter in the priority list shall be evaluated to select one of the technique options made available by the previous routine. The resources required to generate each technique shall be determined and technique assignments shall be made starting at the top of the priority list and assigning higher priority emitters their highest ordered option based upon available resources. Those emitters whose priority preclude assigning any of the options shall not be jammed.

3.2.5.4.4 Response Programming

Once technique options have been selected, external units shall be programmed to implement the required responses.

3.2.5.5 <u>PDW Processing</u>

PDW processing shall consist of programs which process pulse by pulse data contained in PDWs associated with individual track files. These programs shall be designed to extract information not available directly from the SS which will be required for portions of the classification and the resource management programs. The PDW input data are obtained from the SS auxiliary bus. The SC shall request that SPDWs be transmitted for up to eight track files simultaneously. Processing shall extract scan, frequency and pulse repetition characteristics.

3.2.5.5.1 Scan Analysis

The scan analysis program shall process SPDWs associated with specified emitter track files and shall classify the scan type and determine the scan rate. The scan type shall be classified as one of four types: steady, conical, sector, or circular scan. Scan rate shall consist of an estimate of the main lobe illumination rate generated by the emitter.

3.2.5.5.2 Frequency Analysis

The frequency analysis program shall process SPDWs associated with specified track files and shall classify the frequency modulation type and certain associated parameters.

3.2.5.5.3 PRI Analysis

The PRI analysis program shall process SPDWs associated with specified track files and shall classify the PRI modulation according to type and shall measure certain parameters.

3.2.5.6 <u>Display and Control</u>

The display and control program shall include all routines required to generate display data and to respond to operator commands. The display program shall generate data for two display modules, an alphanumeric readout and a polar situation display. Operator commands include requests for display data or modes, and a limited set of override functions.

3.2.5.6.1 Polar Display

The polar display shall display the highest lethality in each of 64 angle cells. It shall be updated once every second or whenever the operator requests a change in mode. The operator may designate that all threat platforms be displayed or that only those be displayed which are of a designated type, in the top 8 priorities, or at a designated bearing. When the operator designates the last option, all platforms at the designated bearing shall be displayed in angle cells adjacent to the designated bearing and positioned according to relative lethality. The parameters of a platform to be displayed shall be those of the highest lethality ETF entry

in a given platform chain. In addition, at each update, the cursor and hook symbols (normally positioned by the operator) shall be repositioned by this program so that they follow the platforms which they designate.

3.2.5.6.2 Alphanumeric Display

The alphanumeric (AN) display operates in one of two modes. In the parameter mode, parameters of an operator designated ETF entry shall be displayed and shall be updated once every 10 s or whenever the operator causes the technique or priority of the displayed ETF entry to change. In the list mode, parameters of eight ETF entries shall be displayed. The priority list (3.2.5.4) shall be divided into pages with eight ETF entries to a page. The operator will specify whether the number representing the chosen page is to be incremented or decremented, and this function shall maintain the chosen page. That page shall be examined once every 10 s to determine which ETF entries shall be displayed in the list mode. Parameters shall be updated at the same time and whenever the operator causes the technique or priority of a displayed ETF entry to change.

3.2.5.6.3 Operator Override

Provisions shall be included to respond to two types of operator override: priority assignment and response assignment.

3.2.5.6.3.1 Priority Assignment. The operator shall be provided the capability to designate the exact priority assignment given to any existing track file. The computer program shall alter existing responses if necessary, to accommodate the priority assignment. The emitter shall retain the assigned priority until the operator reassigns a priority or reverts back to normal operation.

3.2.5.6.3.2 Response Assignment. The operator shall be provided the capability to designate the exact technique response to be implemented against any existing track file. The computer program shall assign resources to implement the operator selected response in accordance with normal program algorithms using the existing priority. The operator designated technique shall remain the primary technique until revised by the operator or until the operator commands a return to normal operation.

3.2.5.6.4 Other Functions

Indicators shall be maintained that indicate the presence of any of several types of emitters in the ETF. Whenever the operator requests a system test, this function shall command the test function to begin such a test and shall cause the display to display temporarily only those ETF entries which are designated as test entries. When system test ends, the display shall be commanded to return to its state prior to the system test.

3.2.5.7 System Management

System management shall consist of programs which provide overall system control and data distribution and which are not contained in other processing functions.

3.2.5.7.1 Signal Threshold

The input signal threshold shall be controlled by the SS to prevent signal processing overloads. Control of this threshold shall be derived from the SS buffer status which is transmitted as buffer full alerts to the SC. The control algorithms shall set the threshold to the maximum sensitivity consistent with a pulse rate which does not overflow the input buffer.

3.2.5.7.2 Track File Overflow

The SC shall respond to emitter track file overflow alerts generated by the SS. These messages are generated when the number of emitters exceeds the number of available track files within the IEWS. When this condition occurs, the SC shall purge nonpriority emitters as long as new emitter messages are being received.

3.2.5.7.3 New Emitter Search Unit (NESU) Blanking

The SC shall monitor the aircraft altitude and shall blank the SS NESU whenever pitch or roll exceeds preset limits in order to prevent new emitter overload during maneuvers.

3.2.5.7.4 Navigation Data Distribution

The SC shall retrieve aircraft position and altitude data from the internal navigation system and shall distribute data as required. Aircraft altitude shall be stored for use by resource management. Aircraft heading shall be used to calculate the azimuth compensation factor used by the parameter encoder to convert signal bearing to true azimuth.

3.2.5.8 Device Interfaces

Device interface shall consist of a set of program modules which contain formatting routines for output data and decoding routines for input data. These modules shall serve as a link between the operational processing programs and the I/O service programs included as part of the executive program.

3.2.5.9 Nonoperational Support

Nonoperational support shall consist of programs which are required to operate SC but are not normally executed as part of any signal processing routine.

3.2.5.9.1 Program Load

The SC shall be provided with a program which allows the unit to perform a self load from a magnetic tape cassette either upon power up or in response to an operator command.

3.2.5.9.2 Program Dump

The SC shall be provided with a program to dump the memory contents. This program shall allow the maintenance operator to dump portions of any memory module into the instrumentation interface.

3.2.5.10 Built-In Test Program

A built-in test program shall be included which performs an end to end confidence verification. The test shall consist of programming the techniques generator to cause a synthetic signal to be injected into the IEWS receiver unit. This signal shall possess unique parameters which allows the SC to classify the signal with a special test identification. The display will be put into a mode which displays only the test emitters. The operator then evaluates the display to determine system operational status. This program shall be initiated by the system operator and shall remain in effect until terminated by the operator. All normal processing will proceed during this test mode.

3.3 DETAILED FUNCTIONAL REQUIREMENTS

3.3.1 EXECUTIVE FUNCTION

3.3.1.1 Inputs

Inputs to the executive function are summarized in table 4.

Table 4. Executive Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Block Control Word	Scheduler and block that is executive			1 word		
	Interruptable	Scheduler					
	Block Complete	Block					
	Module Complete	Block					
	Sequence Complete	Scheduler					
	Waiting (Wait State)	Scheduler					
2	Next Block	Scheduler/Block			1 word		Pointer to next block
3	Data Pointer	Scheduler/Block			1 word		Points to list of parameters

3.3.1.2 Processing

The IEWS SC executive module operates in two modes. Mode one, or foreground, is a service mode which responds to and services interrupts. In mode two, or background, control is given to ECM processing. The executive module gives control and can regain control at its option thus, it is a foreground function.

The interrupt and polling subfunction performs the overall direction of the foreground activities. These activities are performed by the first level interrupt handler (FLIH) in direct response to an interrupt and by the second level interrupt handler (SLIH) which performs the tasks required by interrupts or polling. Polling occurs at the completion of the SLIH tasks. When the results of polling indicate further requirements for performing interrupt tasks, control is returned to the SLIH. The responsibility for scheduling of tasks is delegated to the queuing subfunction. The order and structure of the queues determines the priority of the task to be processed. The system timing subfunction provides a system clock to insure orderly flow. The intercomputer subfunction monitors the intercomputer interfaces. The remaining bookkeeping functions are handled within the executive function. The executive function, by its breakdown into four nearly autonomous subfunctions, is reduced to a monitor and controller of the subfunctions.

3.3.1.2.1 Interrupt and Polling Subfunction

The SC software shall respond to interrupts from devices attached to the SC and shall service message handling between these devices and the SC. Interrupts shall be handled by an interrupt handler software routine (IH). The IH shall be entered each time a hardware interrupt occurs and shall be part of the executive software module. An interrupt causes a change from the background mode to the foreground mode.

The IH shall determine which device interrupted the SC and shall respond in a predetermined manner, usually by an entry in the last-in-first-out (LIFO) queue. Resumption of the task sequence shall be determined by rules dictated by the preemption requirements for the task interrupted.

Polling of input buffers that service the attached devices shall take place on completion of each block within a sequence. Polling shall take place within a range of 2 to 8 ms providing for execution of instructions at a rate of one to four thousand instructions per second. Module sizes and mean time of execution shall be a design criteria consistent with these high polling rates. The polling function shall consist of interrogating external buffers, status words, and internal direct memory access (DMA) buffers. Response to a unit requesting service shall be data movement, and acknowledgement to the originating device for data received.

The difference between interrupt processing and polling is the timing of the event. The interrupt is part of an instruction (takes place during an instruction) and is a hardware poll of status. When an interrupt occurs, the software controls only the response to the interrupt, not the time of occurrence of the interrupt. With polling, the software determines both the response and the time of the poll.

Executive software shall be responsible for reception of emitter data from the sorter. Information from the sorter shall be used to create, update, and maintain an active data base. Algorithms required to perform these services shall be executed by executive software to support a rapid input rate and quick execution time.

3.3.1.2.1.1 First Level Interrupt Handler. The FLIH is the part of the program that responds to interrupts. (See figure 6.) The FLIH shall identify interrupts as to device and type of interrupt, shall respond to interrupts by moving required data, setting indicators for future actions required (LIFO queue entry), clearing the interrupt status, and returning control to the task interrupted. When the processor is idle, the interrupting task is the executive routine which shall then initiate the sequence required by the interrupt. The analysis and scheduler entry of the data shall be performed by the SLIH.

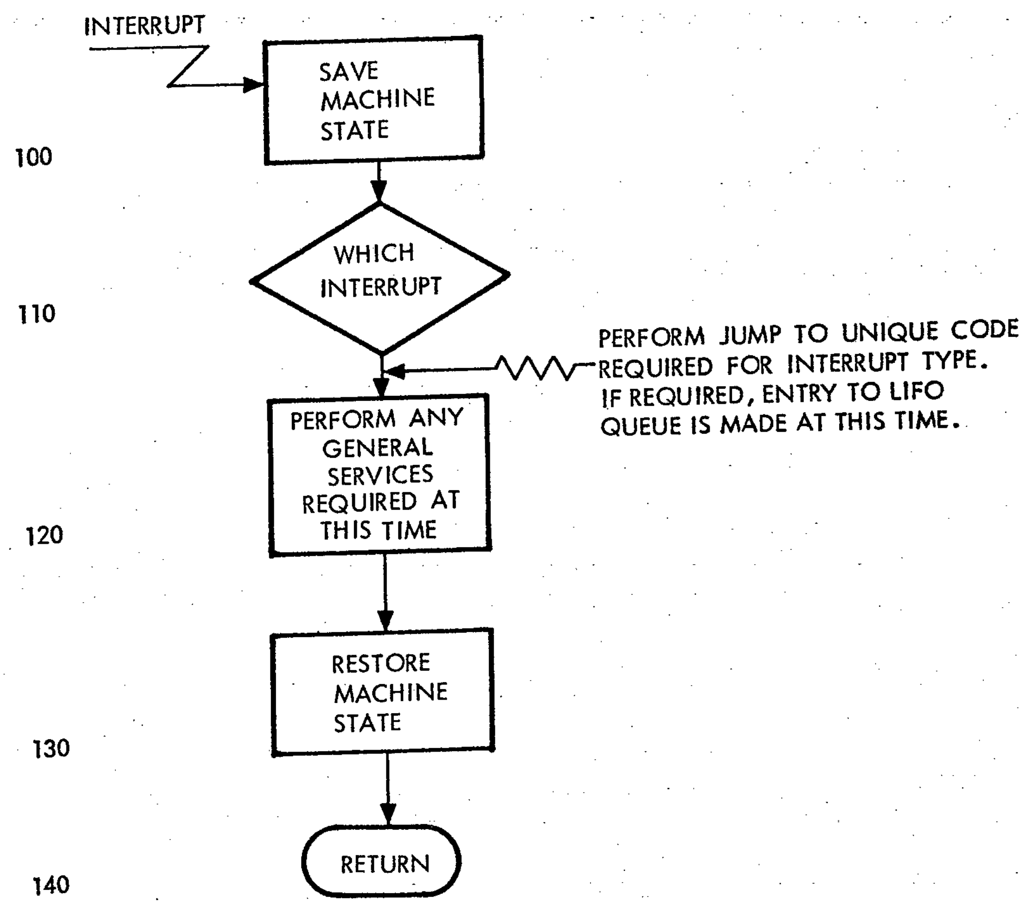

Figure 6. First Level Interrupt Handler

3.3.1.2.1.2 Second Level Interrupt Handler. The SLIH comprises a group of service routines which are entered either in direct response to an interrupt or on the basis of a need for service. (See figure 7.) These routines shall provide for analyzing data to direct it to the proper data base storage, and for scheduling of the processing sequence. The SLIH routines shall be entered as a result of servicing the LIFO queue. On completion of work dictated by the LIFO queue, an entry may be made in the first-in-first-out (FIFO) queue for ECM processing if required, or data files may be updated.

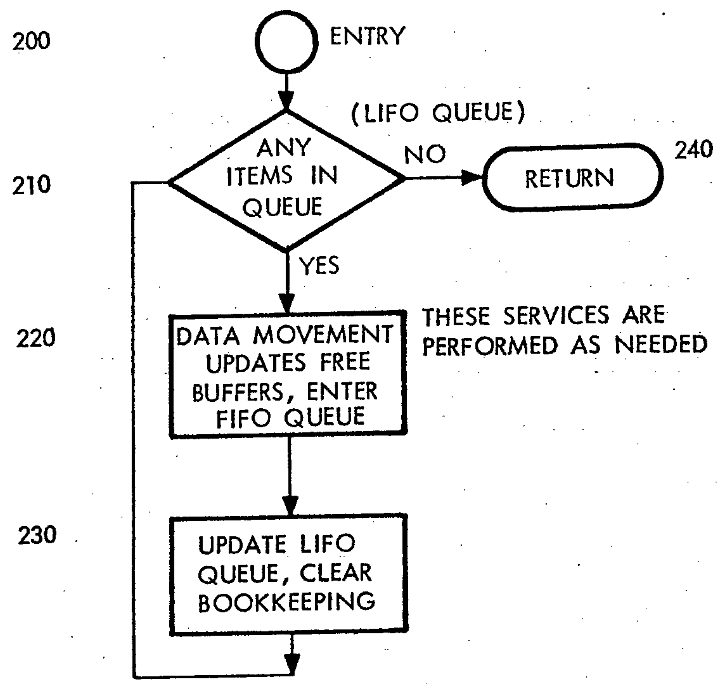

Figure 7. Second Level Interrupt Handler

3.3.1.2.2 Queuing Requested Services and Tasks Subfunction

Foreground functions shall be performed in response to an interrupt or to provide for orderly data movement, execution and communication. To prevent overlap or mishandling of buffers, some foreground functions shall execute in an interrupt blocked mode. The degree of interrupt blocking or masking shall be a design parameter and shall be held to minimum. Background or ECM processing may be interrupted.

When a processor has simultaneous demands for its resources, a method of selection among the competing demands is required. The mechanism for this selection is a queue which has an entry mode in it for each resource demand, and a removal mode from the queue for each demand serviced. The difference in interrupts allowed or disallowed and the degree of nesting allowed by the executive in interrupting its own processing requires two different queues, LIFO and FIFO.

To service the foreground system management tasks, a LIFO queue shall be utilized. A LIFO queue is used because it allows nesting. (Nesting is the interrupting of a task servicing a previous interrupt.) The LIFO queue may be thought of as a push-down, pop-up stack. All entries in the LIFO queue shall be serviced before a return is made to background processing.

The background ECM processing shall be regulated by a FIFO queue. (See figure 8.) As each entry is processed through a sequence of blocks, it shall be removed from the queue. When it is necessary to wait or discontinue processing, that entry pointer shall be removed from the queue and shall remain in an inactive status or shall be inserted on the bottom of the queue.

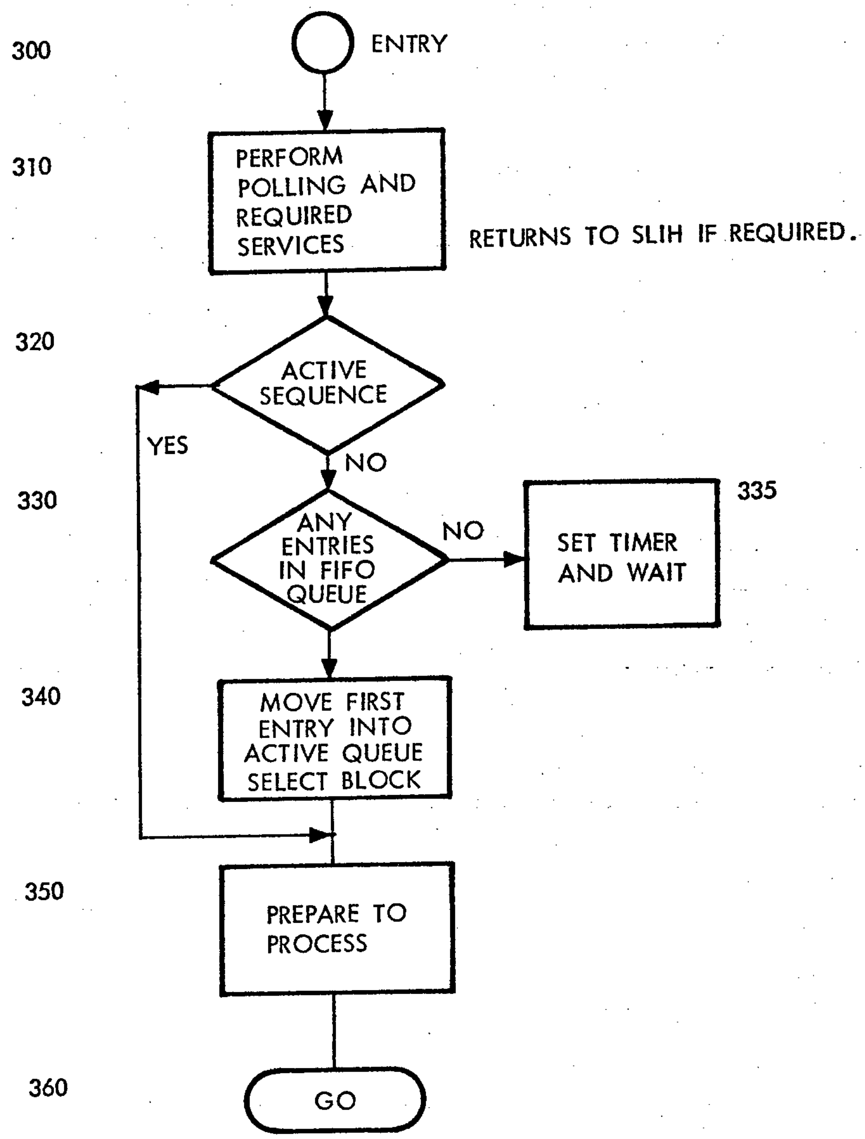

Figure 8. Scheduler Flow Diagram

While the format of an entry within a queue is determined by the resource or sequence that is serviced, some queue attributes remain the same for all queues. The general form is:

Entry No.	First Field	Second Field	Third Field
1	Pointer	Control Data	User Data
2	Pointer	Control Data	User Data
3	Pointer	Control Data	User Data
.			
.			
.			

3.3.1.2.3 System Time Subfunction

System time is required for scheduling of polling and monitoring of software blocks during execution. The system time subfunction shall set and monitor time cells for devices and buffers which require servicing within given timing constraints.

The monitoring of software tasks and algorithms to prevent erroneous looping or halts shall be performed by the system timer. If a sequence is interrupted because of a time-out, this shall be noted within the data base and appropriate response shall be taken. Time monitored shall be execution time, not elapsed time. Execution time differs from elapsed time in that interrupts or preemption may require a task to be inactive for a period of time.

3.3.1.2.4 Intercomputer Subfunction

The intercomputer subfunction shall establish and maintain the protocol required for sharing of memory between two or more processors. This subfunction shall be responsible for setting and clearing of flags indicating usage and direction, the selection of data to place in shared memory, and the format of such data.

Many duties such as data movement can be handled by the ECM tasks rather than as a foreground function. Whenever this can be done without destroying system integrity, it shall be implemented.

3.3.1.3 Executive Outputs

Outputs from the executive function shall be as listed in table 5.

3.3.2 EMITTER TRACK FILE MANAGEMENT AND DATA ACQUISITION

This section of the SC program shall satisfy the requirements for emitter track file management and data acquisition. This includes all operations necessary to process the data received from various sensors or receivers up to the point where the emitter classification module is requested. In general, emitter track files shall be established and maintained within the SC for each signal sensed by or through the external devices. These track files shall be used to locate data uniquely related to each emitter, including data generated by other program modules. The available track file space shall be partitioned into three separate sections, one reserved for pulse signals, one for CW signals and one for AN/ALR-50 associated signals. Each class of signal shall be processed independently. Although segregated, certain link relationships may be established between track files regardless of the section in which they are located.

Table 5. Executive Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Status Word (Status-of-Sequence)	Next block	Executive function		1 word		
2	Parameter Pointer	Next block	Previous block		1 word		Pointer to any parameters required for block

3.3.2.1 Pulse Signals

Pulse signals shall be acquired through the SS unit. Inputs from that unit consist of various PTDW messages and special supplementary flags which the sorter detects as part of its file update procedure. These flags will be passed on to the SC.

3.3.2.1.1 Inputs

The inputs to this module are given in table 6.

3.3.2.1.2 Processing

This program shall establish three interrelated sequences to process PTDW messages from the SS. These sequences shall consist of:

1) new emitter processing,
2) emitter update processing, and
3) inactive emitter processing.

In addition, certain other messages relating to established track files will be processed, which updates file data and status.

3.3.2.1.2.1 New Emitter Processing. A simplified functional flow diagram of the new emitter processing sequence is shown in figure 9. Upon receipt of a new emitter alert message, this program shall establish an entry in the emitter track file and then shall execute a number of validity tests in order to detect various conditions which may cause erroneous results in later stages of the processing sequence. These tests in general will attempt to establish that the emitter descriptor word (EDW) derived from the PTDW is an accurate description of an emitter. The sequence employed for this module shall consist of the steps shown in figure 9.

1) load ETF,
2) test PRI track,
3) test PW,
4) test harmonic PRI, and
5) test frequency.

3.3.2.1.2.1.1 Load ETF. An ETF entry shall be established at a relative location in the range 0 to 127 given by the sorter track file number. The ETF status shall be set to indicate that the file is active and the following contents of the new emitter alert message shall be loaded at the new emitter entry point:

AZ = TAZ
FREQ = TFREQ
PAMP = TPAMP
FA = TA
QPRI = TQPRI
QPW = TQPW
QF = TQF
QAZ = TQAZ

Table 6. Pulse Signal Module Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	New Emitter Alert SFN LTOA NS PP TAZ SCHR PRIA PRIB TCODE TTAMP TPW TQPRI TQPW TQF TQAZ TF TCOUNT TPAMP TV TA TCW TT	Signal Sorter	Interrupt		9 words		
2	Contemporary Report EFNs C VECTOR PDW COUNT	Contemporary Analysis	Prog Sequence		3 words		
3	PTDW SFN LTOA NS PP TAZ SCHR PRIA PRIB TCODE TTAMP TPW TQPRI TQPW TQF TQAZ TF TCOUNT	Signal Sorter	Prog Input		9 words		

Table 6. Pulse Signal Module Inputs (concl)

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
	TPAMP TV TA TCW TT						
4	Inactive File Alert SFN	Signal Sorter	Interrupt		1 word		
5	Multifrequency Flags SFN	Signal Sorter	Prog Input		1 word		
6	Long Pulse Parameters SFN PRIA PRIB PW COUNT	Signal Sorter	Prog Input		4 words		
7	Throttle Alert SFN TFN RF TFA TFF	Signal Sorter	Interrupt		3 words		
8	Scan Meas EFN STYP SPRD	Scan Analysis	Prog Sequence		2 words		
9	CLNK AZ FREQ MLNK PLNK PW QPRI STYP SPRD MF PRI FLNK BLNK ELN	Emitter Track File	Data File Access		8 words		

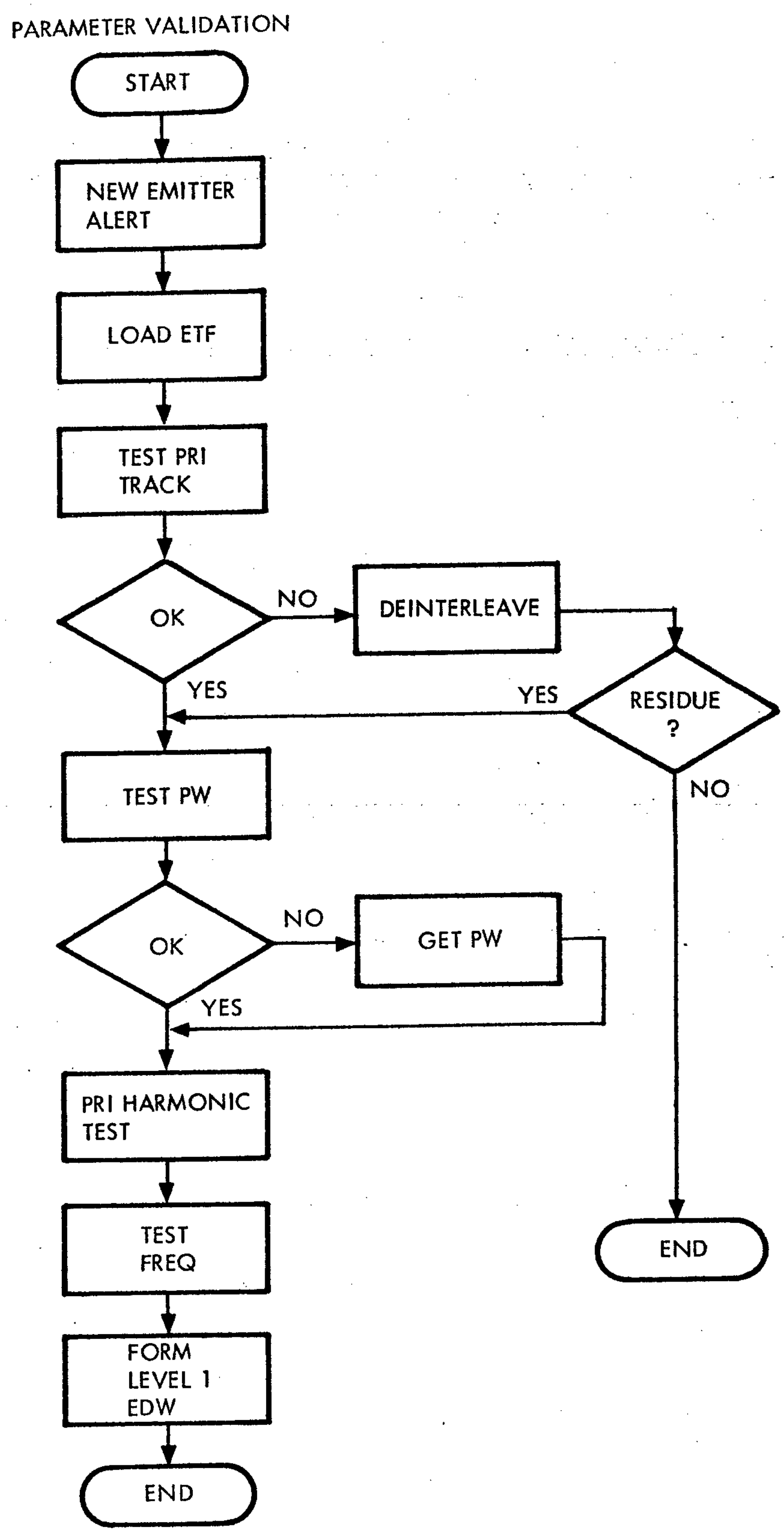

Figure 9. New Emitter Processing Flow Diagram

3.3.2.1.2.1.2 PRI Track Validate. This program shall test the PRI related fields to determine if the sorter has been successful in establishing a PRI track on the signal. Specifically, this test shall consist of the following operations:

Let $$M = \left[\log_2 \left(\frac{PRIA + PRIB}{2}\right)\right]$$

If QPRI < M - 2, then PRI track OK.

If QPRI > M - 2, then call deinterleaving module.

If the QPRI test is valid, then a satisfactory track has been established, and the module shall set AVPRI = $\frac{PRIA + PRIB}{2}$ in the ETF. The sequence shall then proceed.

If the QPRI test fails, then multiple signals may have been acquired and the program shall call the PRI deinterleaving module. All ETF entries established as a part of the PRI deinterleaving shall be handled as new emitters. This sequence shall continue processing the emitter track file with whatever pulse residue, if any, remains after the deinterleaving operation. If no residue exists then the track file shall be cleared and the process terminated.

3.3.2.1.2.1.3 Long Pulse Data. This module shall determine if the emitter has generated a short pulse or long pulse PDW sequence and shall enter the correct code into the emitter track file. This test shall consist of the sequence shown in figure 10.

If the reported pulse width is less than 3.6 μs, the emitter is in a short pulse mode and the reported PW value shall be entered into the ETF. If the reported pulse width is indicated as greater than 3.6 μs, this process will halt until a long pulse message is received from the SS. When this message is received, the interval count will be entered into the ETF with a one appended as a prefix in the MSB position.

3.3.2.1.2.1.4 Harmonic PRI Lock. The module shall test the PRI value to determine if the signal sorter is tracking a harmonic value of the emitter PRI. Basically, this test shall involve comparing the PRI value of the emitter under consideration with emitters derived from the same relative azimuth location. An attempt shall be made to locate a harmonic relationship between the emitter under consideration and those at the same azimuth location.

The azimuth candidate list shall be formed by locating emitter track files which satisfy the following conditions:

1) $AZ_j = AZ_i \pm 1$

2) $F_j = F_i \pm 2^{(QF_i - 2)}$

3) $PW_j = PW_i \pm (QPW_i - 1)$

where i = emitter under consideration

j = azimuth candidate

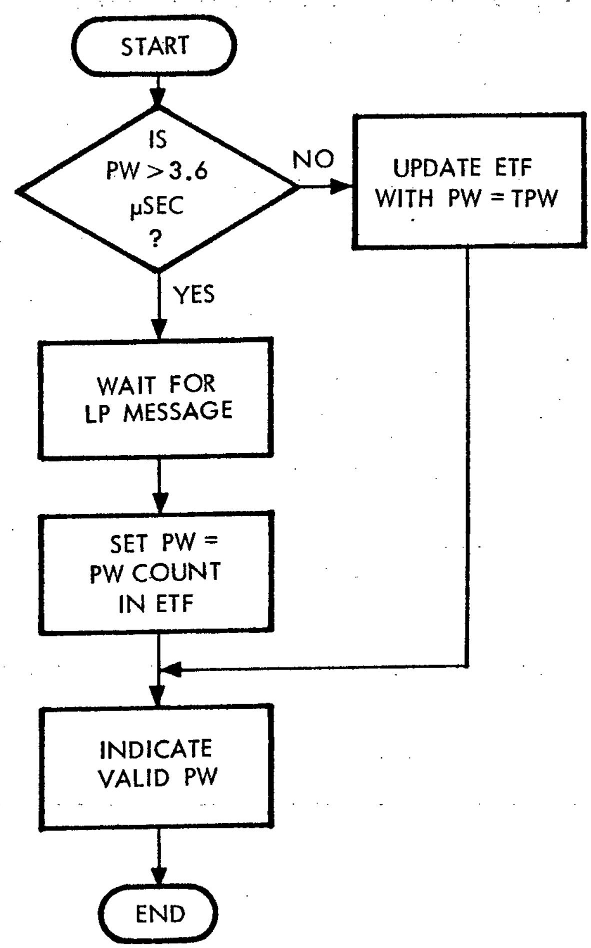

Figure 10. Pulse Width Validation Logic Flow Diagram

If any candidates are found, the harmonic test shall consist of the following operations. Let π_i represent the PRI of the input emitter (IE) being processed. The conditions to be detected for harmonically related PRI are as follows:

$$\left| n\,\pi_i - m\,\pi_j \right| \le \epsilon$$

where ϵ = specific program constant

m, n = harmonic integers 1, 2, 3, 4 or 5

π_j = PRI for selected entry from the azimuth candidate list

If harmonically related emitters are found, a contemporary analysis shall be requested to determine which harmonically related azimuth emitters are contemporary with the IE. If emitters are found to be contemporary, those emitters and the IE shall be deleted in the signal sorter causing the signal to be reacquired through the NESU in the SS. If no contemporary indication is found, no files shall be deleted.

3.3.2.1.2.1.5 Frequency Check. The module shall check the frequency value received to determine if it is the default value encoded when no IFMR output is available. If the frequency is the default value, invalid frequency shall be indicated for use in the classification program. If the frequency is not the default value, valid frequency shall be indicated.

3.3.2.1.2.1.6 Validity Indication. The module shall provide an indication of the validity of the frequency, PRI, and pulse width fields to the level 1 search module.

3.3.2.1.2.2 Emitter Update. The pulse emitter update module shall use the PTDW update message generated by the signal sorter to initiate the update cycle for each emitter track file. The primary purpose of this program shall be to detect any potential change in the emitter status and to initiate a sequence of program operations to respond to any such change. The functional organization of this program is shown in figure 11.

The classification code shall be checked to determine the results of previous classification attempts. The test is designed to detect one of three states.

Class = NOFA 1	The emitter failed to match any of the level 1 library descriptors.
Class = NOFA 2	The emitter failed to match any of the level 2 library descriptors.
Class = Other	The emitter currently has a positive classification given by the entry code.

If the classification code is NOFA1 or NOFA2 then a test shall be made to determine if any significant change has occurred in the level 1 or level 2 EDW since the original entry with the emitter track file. The current EDW shall be compared to the original EDW and if a change exceeding specified limits is detected, the emitter track file entry shall be updated and the emitter shall be classified using the same sequence as for a new emitter. If no change is detected, the emitter track file retains the original entry and the update sequence is terminated.

If the classification entry code is neither of the codes described above, a test shall be made to determine if the EDW still matches the discriminants corresponding to that library file entry. If the EDW still matches the discriminants of the library entry corresponding to the previous classification, the processing sequence shall continue with the link analysis for emitter update and subsequently into resource management update processing. If the EDW no longer matches the library discriminants, the present classification shall be considered no longer valid, and the emitter shall be reclassified using the procedure for new emitters.

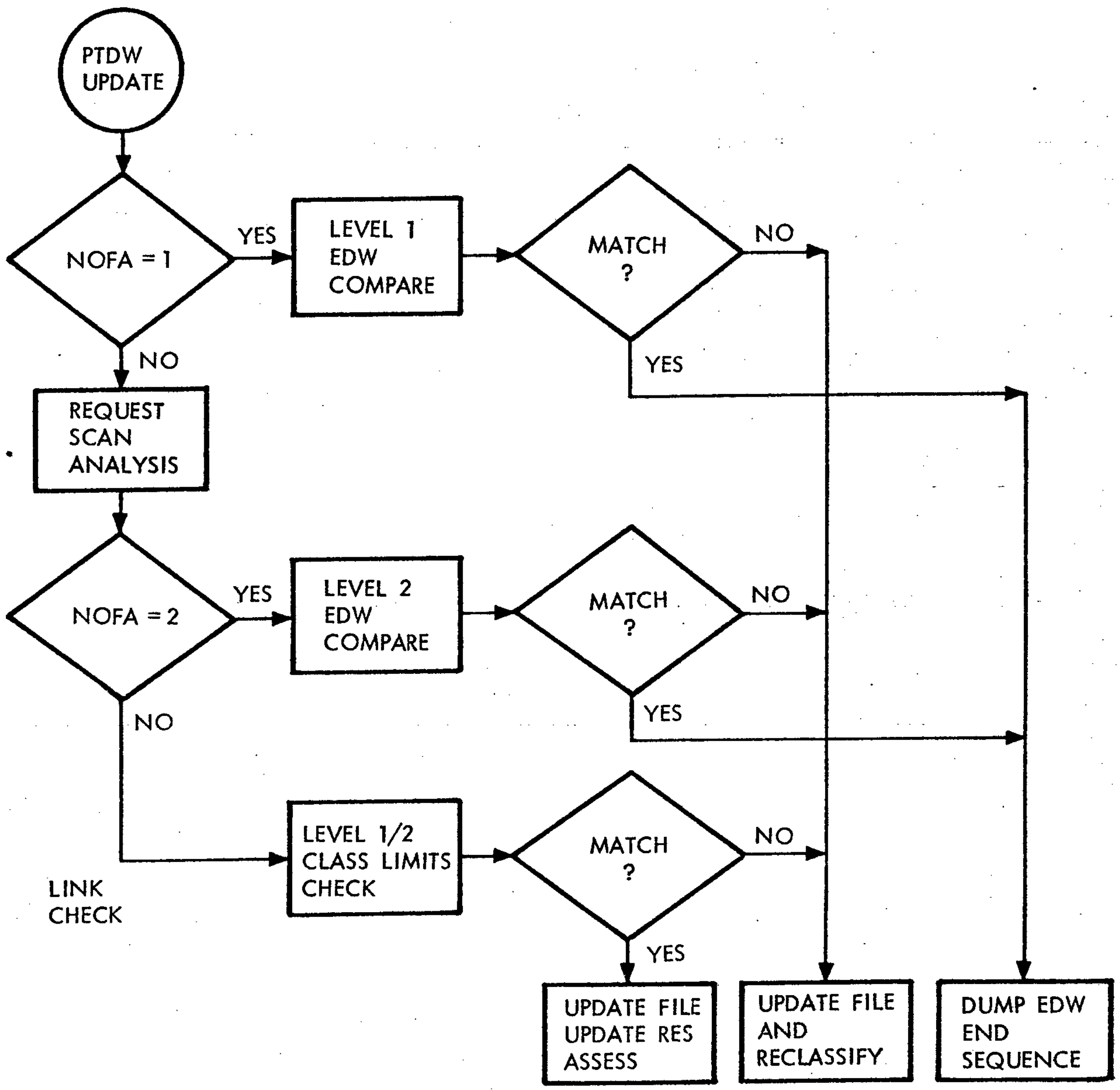

Figure 11. Update Sequence Logic Flow Diagram

3.3.2.1.2.3 Delete Emitter Track File. Inactive track file messages generated by the SS shall initiate a sequence within the SC to purge track files when the emitter is no longer active. Since an emitter may generate several files, the link code must be tested to determine if any changes in the link structure are caused by the deleted emitter. The program sequence to be implemented is shown in figure 12.

The first operation shall be to test the link code. If the track file has no links, then it shall be purged and the resource assessment module alerted to terminate any response associated with that track file. If the deleted file is linked to other files, a link analysis shall be requested. The module shall delete the ETF entry and shall send an update message to the response assessment module.

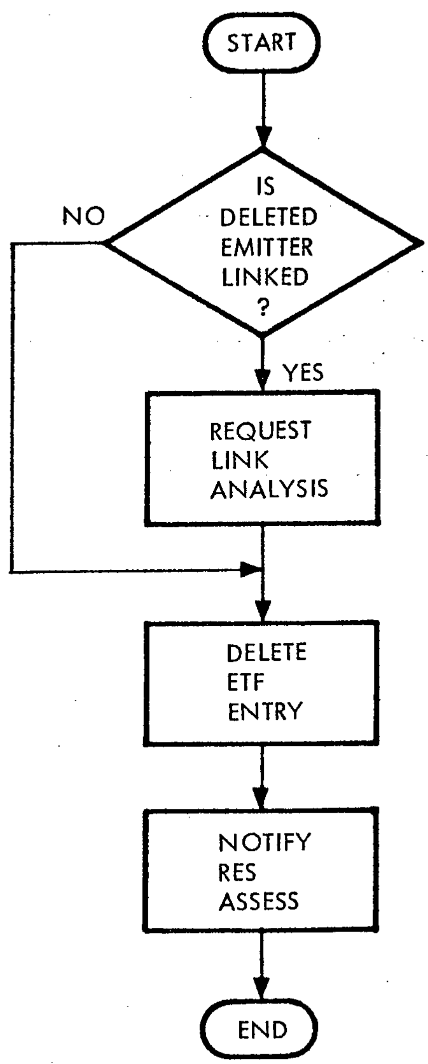

Figure 12. Emitter Purge Logic Flow Diagram

3.3.2.1.2.4 Multifrequency Flags. The multifrequency flags (MFF) module shall accept the MFF message from the SS. The MFF module shall check the multifrequency (MF) bit for the ETF entry indicated by the MFF message. If the MF bit is set, the sequence shall exit. If the MF bit is not set, the MFF module shall set the MF bit, and shall request identification by the level 1 search module. The MFF module shall then exit.

3.3.2.1.2.5 Throttle Alert. The throttle alert (TA) module shall accept the throttle alert message from the SS. The TA module shall set the throttled emitter bit for the ETF entry indicated by the TA message. The reduction factor and the throttle file number for the throttled emitter shall be stored in the ETF. The TA module shall then exit.

3.3.2.1.3 Pulse Signal Module Outputs

The outputs from this module shall be as given in table 7.

3.3.2.2 Continuous Wave Emitters

The CW module shall accept CW detection messages from the IFMR and shall command the HR to measure the CW emitter. Periodically, the CW module shall command the HR to a specific subband to verify that the CW emitter is still active. The CW module shall keep the ETF updated with the latest status on the CW emitter. The CW module shall delete inactive CW emitters.

3.3.2.2.1 Continuous Wave Module Inputs

The inputs to this module shall be as given in table 8.

3.3.2.2.2 Continuous Wave Module Processing

The CW processing shall be divided into three functional areas:

1) signal acquisition,
2) signal tracking, and
3) signal deletion.

3.3.2.2.2.1 Continuous Wave Module Signal Acquisition. The CW module shall accept the CW detection message from the IFMR. The CW module shall decode the subband information and shall determine the start and end frequencies for an acquisition search based on a stored CW search table. The CW module shall output to the HR the start frequency, the end frequency, and an enable.

The CW module shall accept CWDWs from the HR and shall compare the frequency of the received CW emitter against the frequency of each CW emitter in the ETF at the same azimuth ±1 cell. If

$$\left| CFREQ_{NE} - FREQ_{AE} \right| \le K_{cw}$$

where NE = new emitter,

AE = azimuth emitter, and K_{cw} is a programmable parameter,

Table 7. Pulse Signal Module Outputs

ITEM	TASK / DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Track Priority Modify SFN 1 Sec Update 4 Sec Update File Activity Status Purge Time	Signal Sorter	Prog Output		2 words		
2	Delete File SFN	Signal Sorter	Prog Output		1 word		
3	Update Message EFN	Response Assessment	Prog Sequence		1 word		
4	Link Analysis Request EFN PCODE	Link Analysis	Prog Sequence		1 word		
5	Identification Message EFN	Level 1 Search	Prog Sequence		1 word		
6	PDW Analysis Req STFN = EFN Contemporaneous EFNs Scan Analysis Contemporaneous Analysis	ABI Management	Prog Sequence		1 word		
7	FACT AZ FREQ PAMP FA PW QPRI APW QF QAZ CLNK MLNK PLNK MF SM TH RF TFN	Emitter Track File	Data File Store		8 words		

Table 8. Continuous Wave Module Inputs

ITEM	TASK / DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	CW Detection Subband	IFMR	Polling		1 word		
2	CWDW Frequency Azimuth Amplitude	Heterodyne Receiver	Polling		2 words		
3	End of Dwell	Heterodyne Receiver	Polling		1 word		
4	Update Command	Executive	Prog Input		1 word		
5	Azimuth Frequency FACT PAMP CW	Emitter Track File	Data File Access		2 words		

the CW module shall update the existing ETF entry by storing the contents of the CWDW in the ETF. If the inequality above is not satisfied, the CW module shall establish an ETF entry for the CW emitter by indicating an active entry and entering the following data into the CW section of the ETF at a receive location in the range of 125 to 159:

AZ = CAZ

FREQ = CFREQ

PAMP = CAMP

CW = 1

The CW module shall establish an entry in the ETF for every CW emitter reported by the HR during an acquisition search until an end-of-dwell message is received from the HR. Each time an ETF entry is established, the CW module shall notify the level 1 search module that a valid EDW resides in the ETF at the location of the new CW emitter.

If an end-of-dwell message is received from the HR, the CW module shall disable the HR.

3.3.2.2.2.2 Signal Tracking. The CW module shall accept an update command generated every second by the interval timer. Upon receipt of an update command, the CW module shall command the HR to perform an update search through each subband indicating a CW detection. Specifically, the CW module shall send the following data to the HR for each CW emitter in the ETF:

1) start frequency,
2) end frequency,
3) dwell time, and
4) enable.

For active CW emitters which satisfy the frequency limit criterion in 3.3.2.2.2.1, the CW module shall update the ETF entry by storing contents of the CWDW in the ETF. The CW module shall notify the response assessment module of an updated file entry and provide the emitter track file number (EFN).

3.3.2.2.2.3 Signal Deletion. After the end-of-dwell message is received for an update search, the CW module shall determine if all CW signals in that subband have been updated. If any CW signal is inactive, the CW module shall store an indication that the ETF entry is inactive and shall send an update message to the response assessment module.

3.3.2.2.3 Continuous Wave Module Outputs

The outputs from this module shall be as given in table 9.

3.3.2.3 AN/ALR-50

The AN/ALR-50 module shall accept AN/ALR-50 messages from the SS and establish an entry in the ETF for the AN/ALR-50 emitter. The AN/ALR-50 emitter shall be linked in azimuth, correlation, and platform to its companion entry in the ETF.

3.3.2.3.1 AN/ALR-50 Inputs

The inputs to this module shall be as given in table 10.

Table 9. Continuous Wave Module Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Search Command Start Frequency End Frequency Dwell Enable	Heterodyne Receiver	Prog Output		3 words		
2	Update Message EFN	Response Assessment	Prog Output		1 word		
3	Identification Message EFN	Level 1 Search	Prog Output		1 word		
4	FACT Azimuth Frequency PAMP CW	Emitter Track File	Data File Store		3 words		

Table 10. AN/ALR-50 Module Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	AN/ALR-50 Message SFN	Signal Sorter	Prog Input		1 word		
2	Azimuth CLNK OFSET FLNK PLNK ELN	Emitter Track File	Data File Access		3 words		
3	FALNK FCN ELN	Emitter Library	Data File Access		2 words		

3.3.2.3.2 AN/ALR-50 Processing

The SC will receive an AN/ALR-50 message on each update for those emitters which have correlation with an L-band guidance link. The AN/ALR-50 module shall accept AN/ALR-50 messages from the SS and extract the sorter track file number (SFN) which shall then be designated as the EFN of the companion emitter. The AN/ALR-50 module shall create an entry in the AN/ALR-50 section of the ETF in a relative location in the range of 160 to 191. The AN/ALR-50 entry in the ETF shall contain the same azimuth as the companion emitter and shall be linked to it in azimuth, correlation, and platform. The AN/ALR-50 entry shall be made active. The OFSET field shall be set to the value one greater than the present maximum value of OFSET or to 6_8 whichever is less. The emitter library number (ELN) of the AN/ALR-50 emitter shall be determined by entering the emitter library at the ELN of the companion emitter and following the family association link until the AN/ALR-50 library entry is encountered. The value of ELN shall then be stored in the ETF for the AN/ALR-50 emitter. The AN/ALR-50 module shall then exit.

3.3.2.3.3 AN/ALR-50 Outputs

The outputs from this module shall be as given in table 11.

3.3.3 EMITTER CLASSIFICATION

This section describes the program which shall be used to classify all new emitter track file entries and for reclassifying certain other emitter track file entries as part of their update sequence. The classification process shall consist of the following five steps, also shown in figure 13.

1) level 1 search,
2) level 2 search,
3) emitter track file link analysis,
4) family association, and
5) ambiguity resolution.

Level 1 and level 2 search programs shall generate a list of candidate classifications obtained by matching the emitter descriptor word generated for each track file entry being classified against a set of discriminants included as part of each entry in the emitter library. Emitters which produce a candidate list shall then be subjected to a link analysis. This analysis shall consist of a series of operations which associate emitter track files exhibiting characteristics which indicate that they may have been generated by a single weapon system. Family association shall be used to attempt to identify emitters by jointly analyzing the classification codes of all emitters included as members of the linked group. If family associations are detected, the candidates list is modified by purging all nonfamily entries. If the resulting candidate list contains more than one entry, a single entry is selected as the emitter classification by the ambiguity resolution program.

3.3.3.1 Level 1 Search

The level 1 search module shall process an EDW for either pulse or CW signals to produce a candidate list of possible identifications. For a pulse signal the candidate list shall contain the smallest set of emitters in the library that could exhibit the values of FREQ, AVPRI, and PW in the EDW. For a CW signal the candidate list shall contain only those CW signals that could exhibit the value of FREQ in the EDW.

Table 11. AN/ALR-50 Module Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	EFN FACT FLNK AZ CLNK BLNK PLNK ELN OFSET	Emitter Track File	Data File Store		4 words	1 sec	

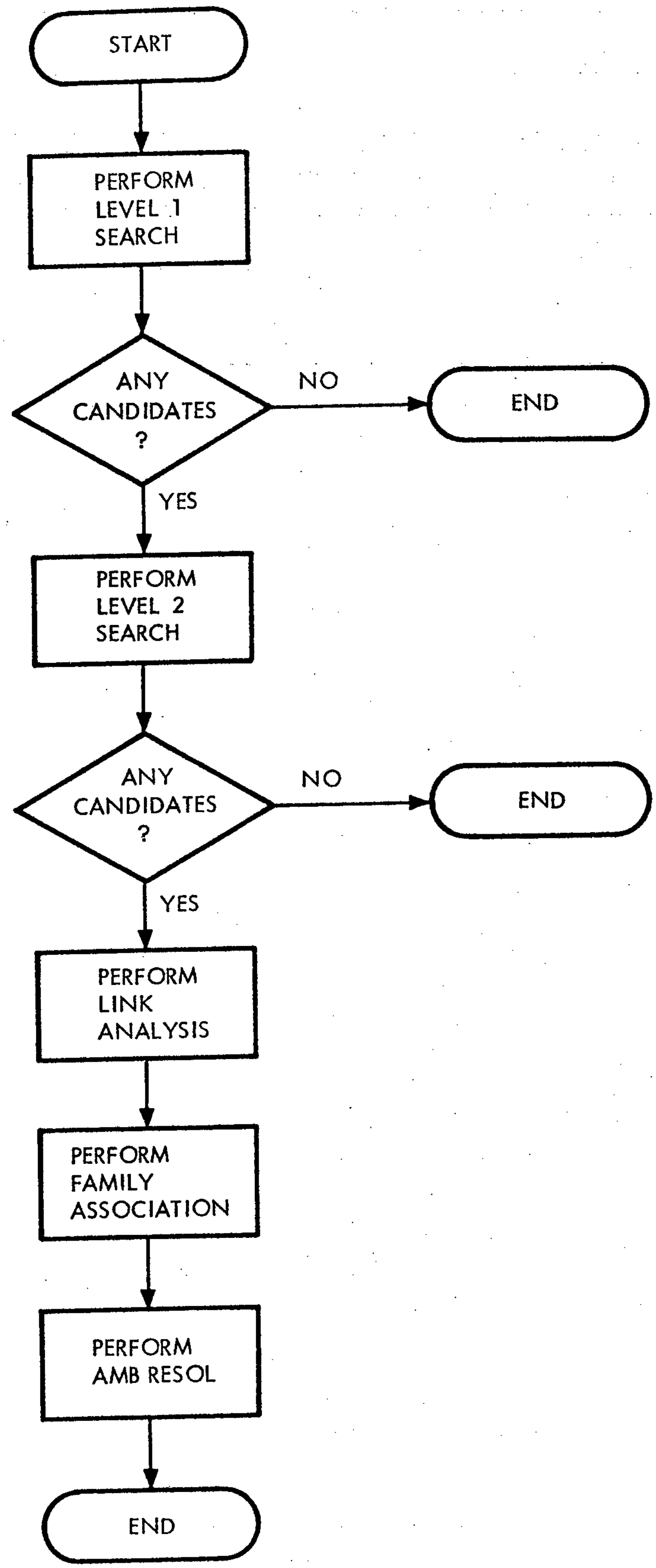

Figure 13. Emitter Classification Logic Flow Diagram

3.3.3.1.1 Level 1 Search Module Inputs

The following notation is used in the item column of the level 1 search module input list which is given in table 12.

Pn	Primary Data Items – This is emitter data or pointers to secondary data.
Sn.m	All data pointed to by primary data item Pn may be data or pointers to other secondary data Sn.m.1, etc.
Di	Cross reference to data base structures, tables, files, etc.

3.3.3.1.2 Level 1 Search Module Processing

The level 1 search module shall execute the logic flow shown in figure 14. It shall determine if the EDW pertains to a pulse or a CW signal by checking the EFN. If the relative location given by the EFN is in the range of 0 to 127, the EDW shall pertain to a pulse signal. If the EFN corresponds to a relative location in the range of 128 to 159, the EDW shall pertain to a CW signal.

If an EDW for a pulse signal is received, the level 1 search module shall check the validity of the FREQ, AVPRI, and PW. The level 1 search shall not be made on invalid parameters. However, the following describes the search for each of the three parameters, indicating those steps which are modified for invalid parameters.

To simplify the notation, let:

$\hat{f}$ = FREQ = frequency of the input emitter

$\hat{\pi}$ = AVPRI = PRI of the input emitter

$\hat{p}$ = PW = pulse width of the input emitter

The level 1 search algorithms shall be strongly associated with the structure of emitter library 1 which is described in 3.4.1. Use will be made of the outer directories and the zone list sections (ZLSs) for each of the three parameters.

The parameter $\hat{f}$ shall be used as a search key for a binary search in the value column of the OD_f, ODV_f. This search shall produce an index i such that

$$f_i \leq \hat{f} < f_i + 1$$

Corresponding to the index i will be an address A_{fi} in the address column of the OD_f, ODA_f. A value of $A_{fi} = 0$ shall imply that no match in frequency exists. If $A_{fi} = 0$, the level 1 search module shall store a none-of-the-above level 1 (NOFA1) indication in the ETF for the input emitter. The level 1 search shall then exit.

If $A_{fi} \neq 0$, the value of A_{fi} shall correspond to an address in the ZLS_f which shall be the key word for a list of emitters E_i $(\hat{f})$ such that

$$E_i\,(\hat{f}) = \left\{ e_1 \,\middle|\, f_i \leq f\,(e_1) < f_i + 1 \right\}$$

Table 12. Level 1 Search Module Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
P1	Identification Message EFN	Data Acquisition	Task Queue	Min: 0 Max: 255_{10}	1 word	-	Emitter File Number
				$0 - 127_{10}$			Regulator Case
				$128_{10} - 159_{10}$			Continuous Wave (CW)
				$160_{10} - 191_{10}$			AN ALR-50
				$192_{10} - 255_{10}$			TBD
S1		Subsection of Emitter Track File (ETF) with Index = EFN ≤ 127_{10}		-	-	-	Emitter Descriptor Word
S1.1	Freq	Subfield: EDW	1	Min: 1600_{10} Max: 14400_{10}	14 bits		Average Measured RF with Granularity = 1.25 MHz
S1.2	AVPRI	Subfield: EDW	1	Min: Max: 20000_{10}	15 bits		Average Measured PRI with Granularity = 1.0 μs
S1.3	PW	Subfield: EDW	1	Min: 0 Max: 31_{10}	5 bits		PW Range Code: for Ranges, see Validation Module
S1.4	Validity Code	Subfield: EDW	1	Min: 1 Max: 7	3 bits	-	Validity Code = $V_4 \cdot V = V_1$
					$V_1 = 0$ No Valid f		
					$= 1$ Valid f		
					$V_2 = 0$ No Valid π		
					$= 1$ Valid π		
					$V_4 = 0$ No Valid p		
					$= 1$ Valid p		
					The Case $V_4 V_2 V_1 = 000$ is detected in the Validation Module and does not reach Class I.		

Table 12. Level 1 Search Module Inputs (concl)

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
D1	EL1						Emitter Library 1
D1.1	EL1/Outer Directories						
	ODV_f RF Outer Directory	Value Section					
	ODA_f	Addresser Section					
	ODV_π PRI Outer Directory	Value Section					
	ODA_π	Addresser Section					
	ODA_p PW Outer Directory	Addresser Section					
D1.2	EL1/Zone List Sections						
	ZLS_f RF Zone List Section						
	ZLS_π PRI Zone List Section						
	ZLS_p PW Zone List Section						
D2	CWEL						Continuous Wave Emitter Library
D2.1	Minimum Frequency Maximum Frequency	CWEL	Data File Access		2 words		

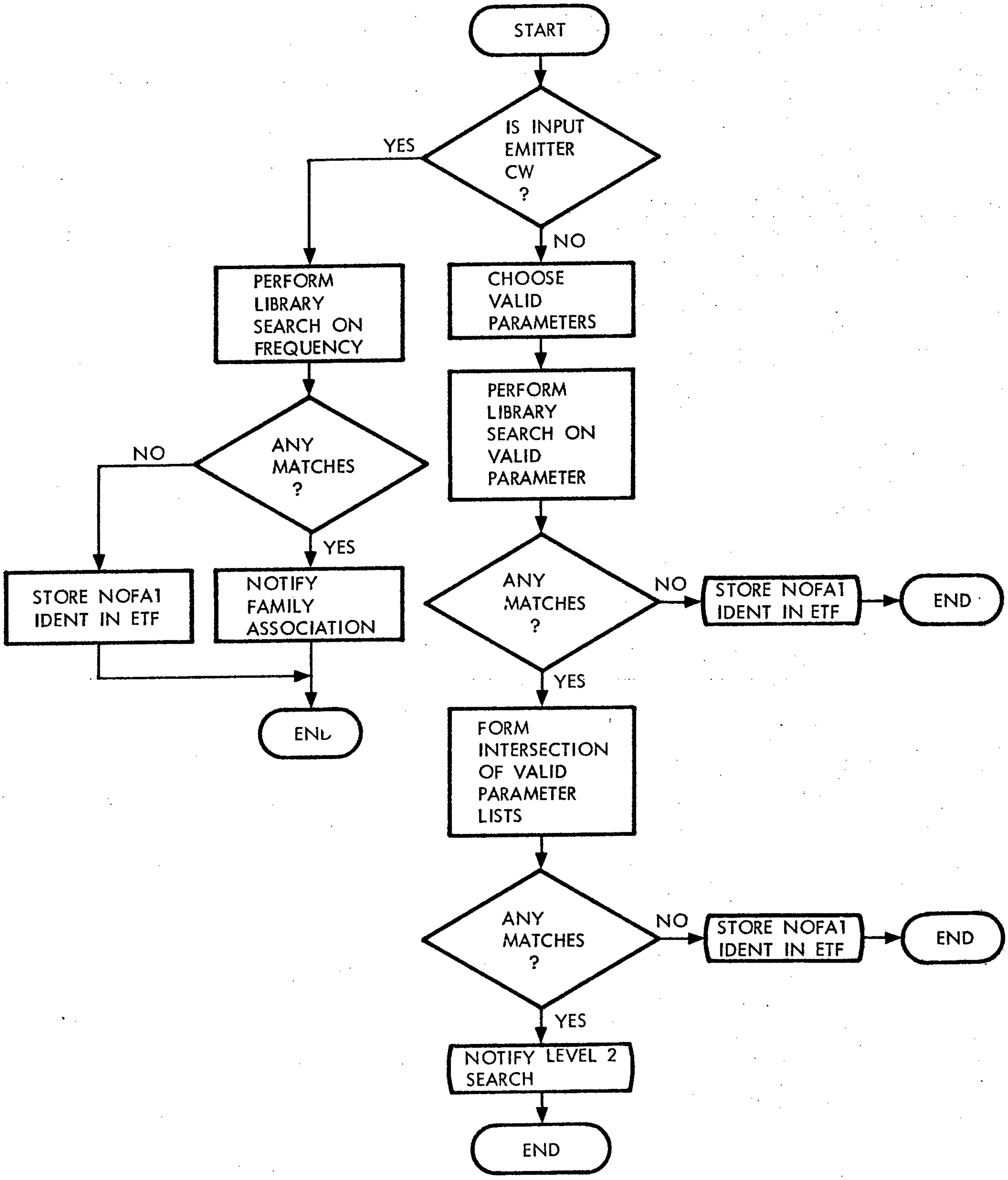

Figure 14. Level 1 Search Logic Flow Diagram

The parameter π shall be used as a search key for a binary search in the value column of OD_{π}, ODV_{π}. This search shall produce an index j such that

$$\pi_j \leq \hat{\pi} < \pi_j + 1$$

Corresponding to the index j will be an address $A_{\pi j}$ in the address column of the OD_{π}, ODA_{π}. A value of $A_{\pi j} = 0$ shall imply that no match in PRI exists. If $A_{\pi j} = 0$, the level 1 search module shall store a NOFA1 indication in the ETF for the input emitter. The level 1 search module shall then exit.

If $A_{\pi j} \neq 0$, the value of $A_{\pi j}$ shall correspond to an address in ZLS_{π} which is the keyboard for a list of emitters $E_j(\hat{\pi})$ such that

$$E_j(\hat{\pi}) = \left\{ e_m \,\middle|\, \pi_j \leq \pi(e_m) < \pi_j + 1 \right\}$$

The parameter p shall be used as an index to address the OD_p directly and extract an address A_{pk}. A value of $A_{pk} = 0$ shall imply that no match in pulse width exists. If $A_{pk} = 0$, then the level 1 search module shall store a NOFA1 indication in the ETF for the input emitter. The level 1 search module shall then exit.

If $A_{pk} \neq 0$, the value of A_{pk} shall correspond to an address in ZLS_p which is the key word for a list of emitters $E_k(\hat{p})$ such that

$$E_k(p) = \left\{ e_n \,\middle|\, \underline{PW}_{\hat{p}} \leq PW(e_n) < \overline{PW}_{\hat{p}} \right\}$$

where $\underline{PW}_{\hat{p}}$ is the minimum value that p could represent and

$\overline{PW}_{\hat{p}}$ is the maximum value that p could represent.

Having obtained one or more lists of emitters, the level 1 search module shall obtain the intersection of the lists using only lists corresponding to valid parameters. If all three parameters are valid, the candidate list E shall be defined as:

$$E = E_i(\hat{p}) \cap E_j(\hat{\pi}) \cap E_k(\hat{p})$$

If E contains no entries, the level 1 search module shall store a NOFA1 indication in the ETF for the input emitter and shall exit. If E contains one or more entries, the level 1 search module shall send a search 2 request message to the level 2 search module and shall exit.

If an EDW for a CW signal is input, the level 1 search module shall perform a sequential search of the CW emitter library to obtain a between-limits match between the frequency of the input emitter and an entry in the library. If a match is found, a perform-association message shall be sent to the family association module. If no match is found, the level 1 search module shall store a NOFA1 indication in the ETF for the input emitter. The level 1 search module shall then exit.

3.3.3.1.3 Level 1 Search Module Outputs

The following notation is used in the item column of the level 1 search module output list which is given in table 13.

Pn	Primary Data Items – This emitter data or pointers to secondary data.
Sn.m	All data pointed to by primary data item pn may be data or pointers to other secondary data Sn.m.1 etc.
Di	Cross reference to data base structures, tables, files, etc.

3.3.3.2 Level 2 Search

The level 2 search module shall use scan analysis to reduce the size of the candidate list received from the level 1 search module. The level 2 search module shall compare the measured scan type and scan period to the corresponding parameters of each candidate. Only those candidates which match shall be retained in the candidate list. The level 2 search module shall pass the reduced candidate list on to the link analysis module.

3.3.3.2.1 Level 2 Search Module Inputs

The level 2 search module inputs are given in table 14.

3.3.3.2.2 Level 2 Search Module Processing

The level 2 search module shall accept EFN of the input emitter being processed and a list of candidates for identification. (See figure 15.) The level 2 search module shall determine if a PDW analysis has been requested. A PDW analysis is always requested for a new emitter and for an update emitter that matches in the level 1 search module. However, an identification requested by the link analysis or the family association modules shall use the scan type and scan period stored in the ETF and shall not request a PDW analysis.

If a PDW analysis has not been requested, the level 2 search shall use the scan parameters stored in the ETF for comparison with the candidate scan parameters.

If a PDW analysis has been requested, the level 2 search module shall check the value of the peak amplitude (PAMP) in the ETF. If the value of PAMP indicates a received amplitude greater than A_T dBm, the level 2 search module shall request scan analysis. If PAMP implies a received amplitude less than or equal to A_T dBm, the level 2 search module shall determine if the input emitter is a new emitter or an update emitter. If the input emitter is a new emitter, the level 2 search shall set the scan type to circular and the scan period to the time-out interval for scan analysis. If the input emitter is being updated, the level 2 search module shall change the scan type to circular and the scan period to the time-out value only if the state indicator is set. If the state indicator is not set, the level 2 search module shall set it and shall then continue.

If scan analysis was requested, the level 2 search module shall accept scan type and scan period from the scan analysis (SA) module. If the scan type returned is sidelobe and if the input emitter is a new emitter, the level 2 search shall set the scan type to circular and the scan period to the time-out interval for scan analysis. If the input emitter is being updated, the level 2 search module shall change the scan type to circular and the scan period to the time-out value only if the state indicator is set. If the state indicator is not set, the level 2 search module shall set it and shall then continue.

If the scan type returned from the SA module is not sidelobe, the level 2 search module shall update the ETF with the returned scan type and scan period.

Table 13. Level 1 Search Module Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
P1	Search 2 Request	Level 2 Search	Prog Output	≠ 0 There was a match = 0 There was no match (error condition)			Request of Output
S1.1	Keyword (AO)			Min: 1 Max: 16			= # of Binary-Bit Vector Words to follow
S1.2	Binary-Bit Vector Words (BBVW)						Last BBVW ≠ 0
P2	Perform Association EFN Pointer	Family Association	Prog Sequence		1 word		
D1	NOFA1	Emitter Track File	Data File Store		1 word		

Table 14. Level 2 Search Module Inputs

ITEM	TASK · DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Search 2 Request EFN Pointer	Level 1 Search	Prog Sequence		2 words		
2	Scan Measurement STYP SPRD EFN	Scan Analysis	Prog Sequence		2 words		
3	Emitter Library Number	Candidate List	Data File Access		1 word		
4	EFN SM AVPI FREQ PW STYP SPRD	Emitter Track File	Data File Access		4 words		
5	Min PRI Max PRI Scan Type Min Scan Rate Max Scan Rate	Emitter Library	Data File Access		3 words		

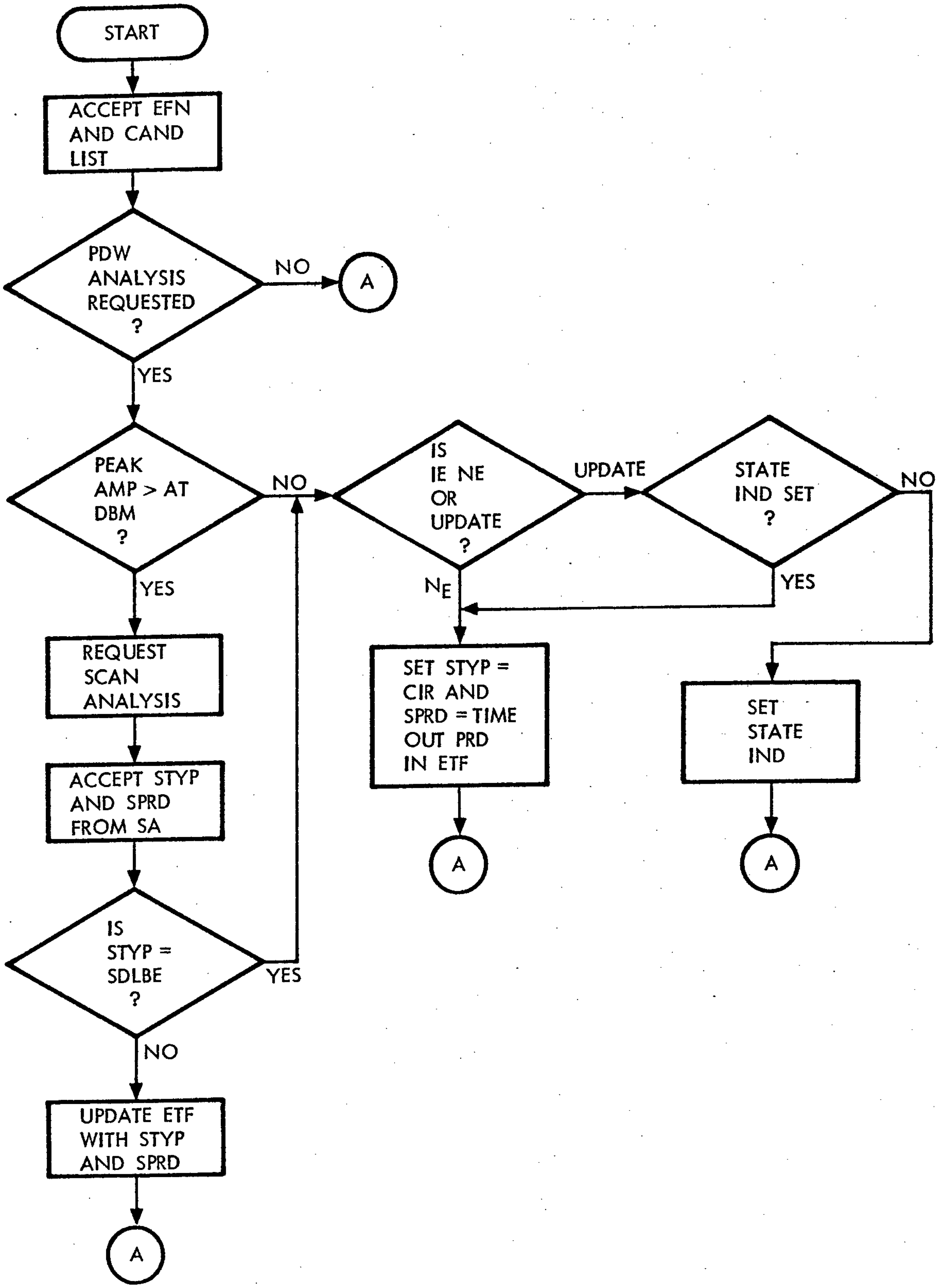

Figure 15. Level 2 Search Logic Flow Diagram (Sheet 1)

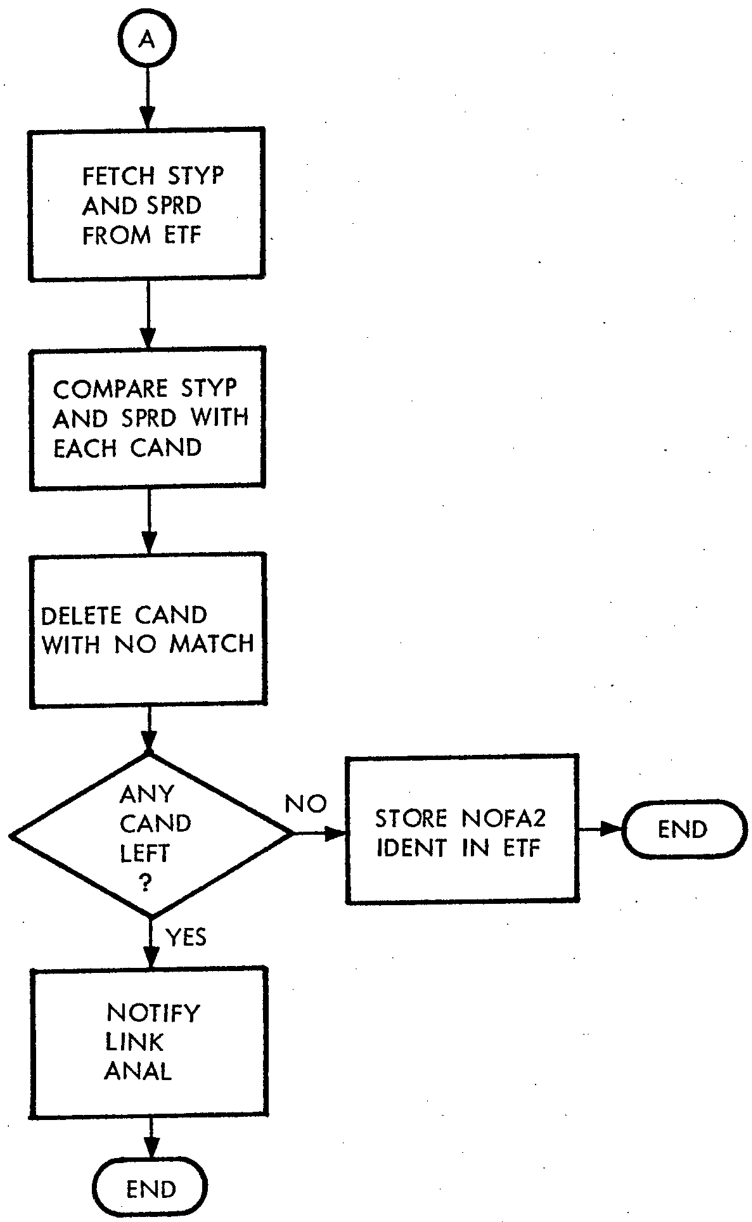

Figure 15. Level 2 Search Logic Flow Diagram (Sheet 2)

The level 2 search module shall compare the emitter being processed and each candidate with respect to scan type. If an exact match occurs, the candidate shall be retained. If there is no match, the candidate shall be deleted from the candidate list. The level 2 search module shall then compare the scan period of the input emitter between the limits of the scan period for each candidate. If no match occurs, the candidate shall be deleted from the candidate list. If a match occurs, the level 2 search module shall continue.

If the reduced candidate list is empty, the level 2 search module shall indicate a none-of-the-above level 2 (NOFA2) identification in the ETF for the input emitter and shall exit. If the reduced candidate list still contains entries, the level 2 search module shall notify the link analysis module and shall then exit.

3.3.3.2.3 Level 2 Search Module Outputs

The level 2 search module shall be as given in table 15.

3.3.3.3 Link Analysis

Signals associated with individual emitter track files shall be analyzed jointly in order to detect certain relationships that would indicate a possibility that multiple track files may have been generated by a single radar system. Track files where such relationships are detected shall be linked to one another forming a group of linked track files. Generally, four types of links shall be established:

1) Agile – Agile links shall designate a group of track files whose associated signal must be merged to form valid emitter descriptors.
2) Correlated – Correlated links shall designate a group of track files whose signals operate in pulse synchronism with each other.
3) Mode – Mode linked track files shall designate a group of signals which operate in nonoverlapping, disjoint time intervals with respect to each other.
4) Platform – Platform shall be a comprehensive group which includes all signals which are related to each other by any of the above types.

3.3.3.3.1 Link Analysis Module Inputs

The link analysis module inputs are given in table 16.

3.3.3.3.2 Link Analysis Module Processing

3.3.3.3.2.1 Link Structure. A link code shall be included as part of each emitter track file entry and shall be organized as shown in figure 16. Four pointer fields shall be defined, one for each link type: agile (A), correlated (C), mode (M), and platform (P). The A, C and M groups shall be formed independently and the P group shall be a comprehensive link encompassing all emitter track file entries related by any of the other three links.

Each pointer field shall reference a single emitter track file location. Generally, such links shall be formed using the following guidelines.

1) Each pointer field except the last entry shall designate the next numerically higher emitter track file location included within the group. The last numerical emitter track file entry shall reference the first entry within the group.

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Table 15. Level 2 Search Module Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Track Priority Mod	Signal Sorter	Prog Output		2 words		
2	PDW Anal Req STFN = EFN Scan Analysis	ABI Management	Prog Sequence		1 word		
3	Link Analysis Request EFN PCODE	Link Analysis	Prog Sequence		2 words		
4	Delete ELN	Candidate List	Data File Store		1 word		
5	reid avpi stag pityp prid styp sprd	Emitter Track File	Data File Store		4 words		

Table 16. Link Analysis Module Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Link Analysis Request EFN PCODE	Level 2 Search or Data Acq (Update or Deletion)	Prog Sequence		1 word		
2	Contemporary Report EFNs C Vector PDW Counts	Contemporary Analysis	Prog Sequence		3 words		
3	ALNK CLNK MLNK PLNK FLNK BLNK AVPRI AZ	Emitter Track File	Data File Access		5 words		

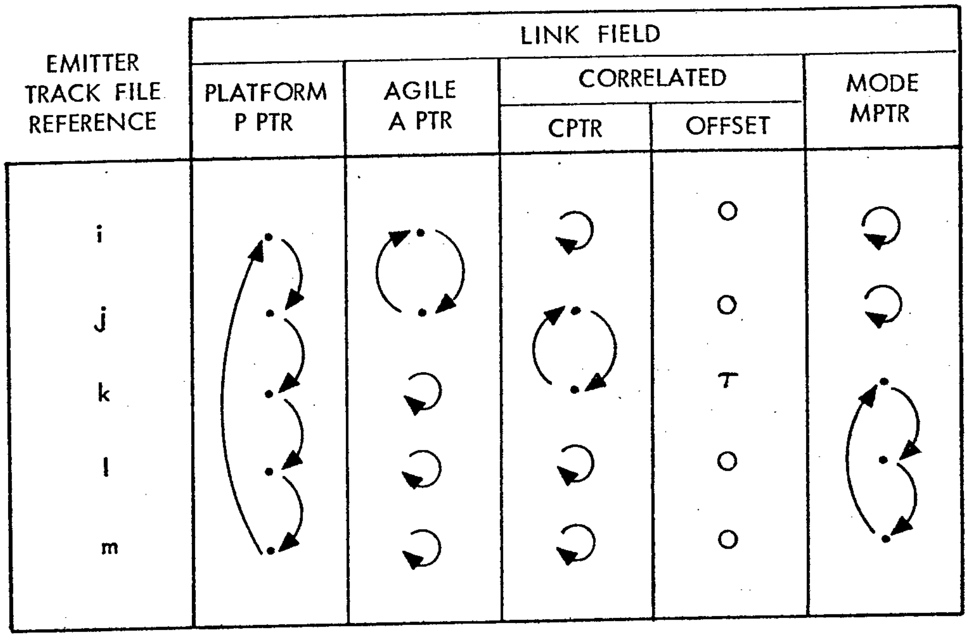

Figure 16. Emitter Track File Update Link Organization

2) All groups within a given category shall be disjoint. That is, a track file entry may belong to only one group within a given link type, such as correlation. No two groups of this same type will contain the same track file entry.

3) Different link categories may overlap. A given track file entry may belong to one agile group, one correlated group, and one mode group.

4) The platform link shall include all emitter track files linked by any of the other three link types.

5) If an emitter track file entry is not linked to any other file, then the link pointer shall reference itself and the group shall contain only a single entry.

3.3.3.2.2.2 Agile Link. The agile field is reserved for system growth. No agile emitters have been defined for system test; therefore, this category will not be included for the advanced development model (ADM) version of the IEWS.

3.3.3.3.2.3 Correlation Analysis. The correlation analysis (CL) module shall attempt to identify those emitter track files where the associated signals are operating in pulse synchronism. New emitters shall be analyzed to determine if they can be included as members of established groups. During emitter updates, the group association shall be analyzed for potential conflicts or inconsistencies and the groups shall be reformed to satisfy the requirements for correlation. The group relationship shall also be analyzed for deleted emitters to determine the impact that removal of a member has on the group associations. The emitter being processed, either new, update, or deleted, will be referred to as the input emitter (IE).

3.3.3.3.2.3.1 Correlation Link Algorithm. The correlation relationship is based upon correlation in azimuth and upon pulse synchronism being detected between groups of signals associated with multiple track files. Detection of the latter condition shall be relaxed somewhat and shall be satisfied if a harmonic relationship exists between reported pulse repetition values. The processing sequence is shown in figure 17.

A set of trial correlated emitter track file groups is generated by a new emitter entry, an emitter update or as a result of deleting an emitter track file. The list of emitter track file references for each group are scanned and a contemporary analysis for the emitters is requested. The resultant contemporary vector is analyzed for each correlation group for contemporaneous consistency. This test shall require that all members of the correlated group return a contemporary indication. Those emitters not returning a contemporary indication shall be deleted from the correlated group.

Those members which survive the contemporary test shall be analyzed for harmonic relationship. Let π_i represent the pulse repetition interval (PRI) of the input emitter. The conditions to be detected for harmonically related PRI shall be as follows:

$$\left| n\,\pi_i - m\,\pi_j \right| \leq \epsilon$$

where ϵ = specific program constant

m, n = harmonic intergers 1, 2, 3, 4 or 5

π_j = PRI for selected entry from the correlated group

The above conditions shall be established among all members of a correlated group. If this test fails, the members which caused the test to fail shall be placed in separate subgroups with all other members of the original group placed in each of these subgroups. The resulting groups shall be analyzed to determine if they form a contiguous set of azimuth values. If a gap appears, the group shall be partitioned into two groups each consisting of a set of contiguous azimuth values. This test shall be repeated until each subgroup contains only emitters with harmonically related PRIs.

If a subgroup is formed which changes the platform link, all of the emitters in that subgroup shall be reidentified.

Following the harmonic analysis and group modification, each subgroup shall be analyzed for disjoint membership. That is each emitter track file must belong exclusively to only one correlated group. If an emitter is found to be a member of two correlated groups, these groups shall be merged into a single group.

If the IE has its MF bit set, those emitters which are correlated with the IE and have their MF bits set also shall be analyzed to see if they are coincident by the following procedure:

1) The CL module shall check the value of OFSET for those azimuth emitters being considered for coincidence. The azimuth emitters shall be divided into groups having the same value of OFSET. The IE shall be included in each group.

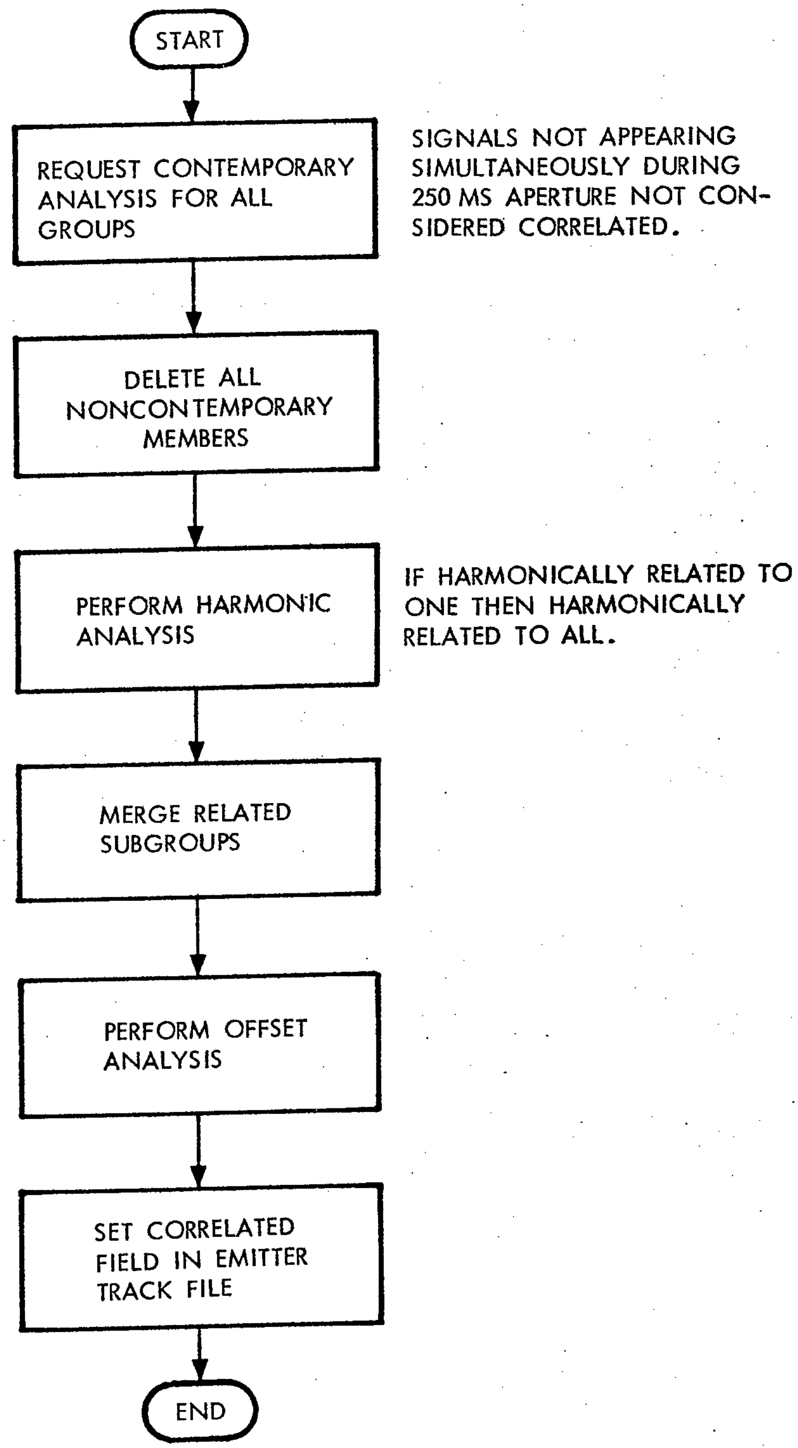

Figure 17. Correlation Analysis Sequence

2) The CL module shall sum the number of PDWs for each group, i.e., if there are M_i emitters in a group, each having n_j PDWs, then the sum N_i shall be

$$N_i = \sum_{j=1}^{M_i} n_j \ , \quad i = 1, 2, \ldots, G$$

where G = number of groups.

3) For each group, the CL module shall determine the minimum or shortest PRI, SPRI. The CL module shall calculate

$$L_i = T \div SPRI_i \, , \quad i = 1, 2, \ldots, G$$

where T = time-out period.

4) The CL module shall compare the values

$$D_i = \left| L_i - N_i \right| \quad i = 1, 2, \ldots, G$$

to a programmable threshold, K.

5) If one or more values of D_i are less than K, the CL module shall choose the minimum and shall set the value of OFSET for the IE to the value of OFSET for that group.

6) If no value of D_i is less than K, the CL module shall set the value of OFSET for the IE to 6 or to one more than the maximum value of OFSET for all the azimuth emitters in the existing correlation group, whichever is less.

If the MF bit for the IE is not set, the CL module shall set the value of OFSET for the IE to 6 or to one more than the maximum value of OFSET for all the emitters in the existing correlation group whichever is less.

The final operation shall consist of updating the emitter track file link and OFSET codes for all emitters involved in this analysis.

3.3.3.3.2.3.2 New Emitter Candidate Groups. When a new emitter is being analyzed, all correlated groups shall be located which have at least one member in the same or the immediately adjacent azimuth cells as the new emitter. A candidate list of correlated groups shall be formed by adding the new emitter as a member of each group.

3.3.3.3.2.3.3 Emitter Update Candidate Groups. When an emitter is being updated, the azimuth position of all emitters which are members of the same group as the IE shall be analyzed to determine if they form a contiguous set of values. If a gap appears, the group shall be partitioned into two groups each consisting of a set of contiguous azimuth values. The original group or the resultant subgroups are then analyzed using the correlation link algorithm.

3.3.3.3.2.3.4 Deleted Emitter Candidate Groups. The logic sequence to delete emitters shall be as shown in figure 18. When an emitter is deleted, the group of which it was a member shall be analyzed to determine if it still forms a contiguous set of azimuth values. If a gap appears as a result of deleting a member, then the group shall be partitioned into two groups, each consisting of a set of contiguous azimuth values. Correlation group formation resulting from deleted emitter sequences need not be reevaluated using the correlation link algorithm. However, the emitter track file link code shall be updated to reflect any change.

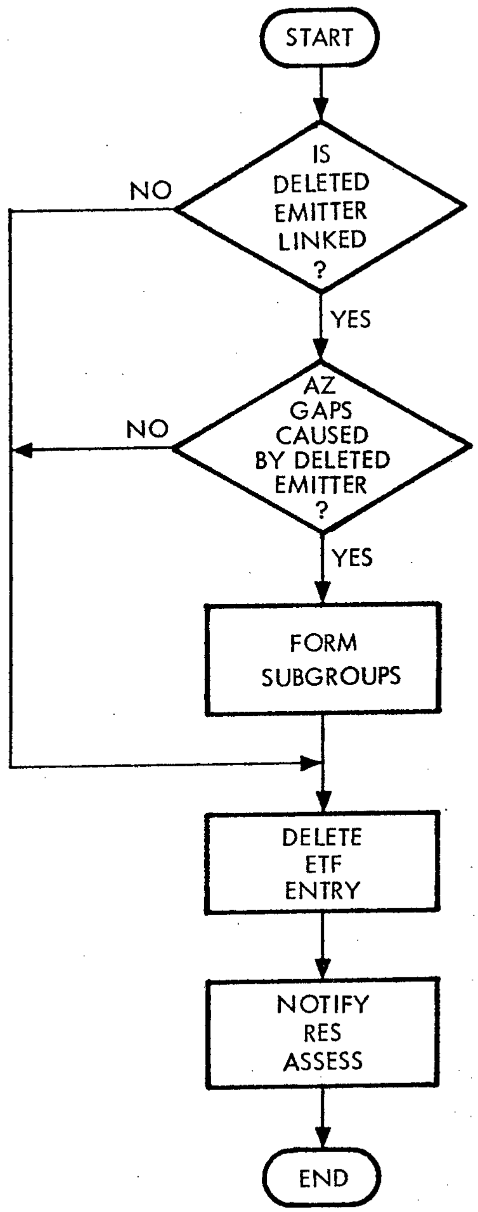

Figure 18. Delete Emitter Logic Flow Diagram

3.3.3.3.2.4 Mode Link Analysis. Mode shall constitute a means of identifying a set of track files which, taken as a group, exhibit the property that the signals associated with such files are correlated in azimuth and are active in nonoverlapping, disjoint time intervals.

New emitters shall be analyzed to determine if they can be included within existing mode groups subject to the above requirement. Emitter update shall cause such track files to be analyzed to determine if the original grouping can be further partitioned into subgroups. If track files are deleted, the group of which it was part shall be analyzed to determine if the grouping is affected by the deleted file and, if so, to repartition the group.

3.3.3.3.2.4.1 Mode Link Algorithm. A mode link is based upon both a correlation in azimuth and the contemporaneous relationship between signals associated with emitter track files. The processing sequence to be used for the mode link analysis is shown in figure 19. A set of mode groups is presented for mode analysis which has been generated as part of a new emitter entry, an emitter update or as part of a delete emitter sequence.

A contemporary analysis shall be requested for the emitter track file associated with each group. The result returned from that analysis is a contemporary vector, c_i, for each mode group.

$$c_i = \left[c_{i1}, c_{i2}, \ldots c_{im_i}\right], \quad i = 1, 2, \ldots, n$$

$$c_{ij} = 1 \text{ if contemporary, } 0 \text{ if not contemporary, } j = 1, 2, \ldots, m_i$$

n = number of mode groups

m_i = number of emitters in i th mode group

Each mode group shall then be checked to determine if all members are consistent on a contemporary basis. This test shall consist of testing each component, c_{ij}, of the vector c_i and noting the number of contemporary results entered. If none or one is detected then the non-contemporaneous condition is satisfied. If more than a single 1 is detected, the original group is partitioned to form subgroups. A subgroup shall be formed for each 1 entered and the members of each subgroup shall contain the ETF entry corresponding to each 1 plus the ETF entries corresponding to all 0 components of c_i. Note that all 0 ETF entries are made part of each subgroup but that there is only a single ETF corresponding to a 1 in each subgroup.

The resulting groups shall be analyzed to determine if they form a contiguous set of azimuth values. If a gap appears, the group shall be partitioned into two groups each consisting of a set of contiguous azimuth values.

The resultant subgroups shall be tested to determine if each subgroup contains an exclusive list of emitter track file entries. This test involves testing the emitter track file entries included in each subgroup to determine if an ETF is a member of more than one subgroup. If each emitter appears in only one subgroup, the exclusive condition shall be satisfied. If not, then those subgroups which cause this test to fail shall be selected for reevaluation by this sequence.

This sequence shall be iterated through N cycles or until both the contemporaneous and the exclusive contraints are satisfied. If the constraints are not met and N cycles have been executed, then those subgroups which are still inconsistent shall be merged into a single subgroup. The link structure in the emitter track file shall be updated at this point to reflect the last subgroup formation.

If a subgroup is formed which changes the platform link, all of the emitters in that subgroup shall be reidentified.

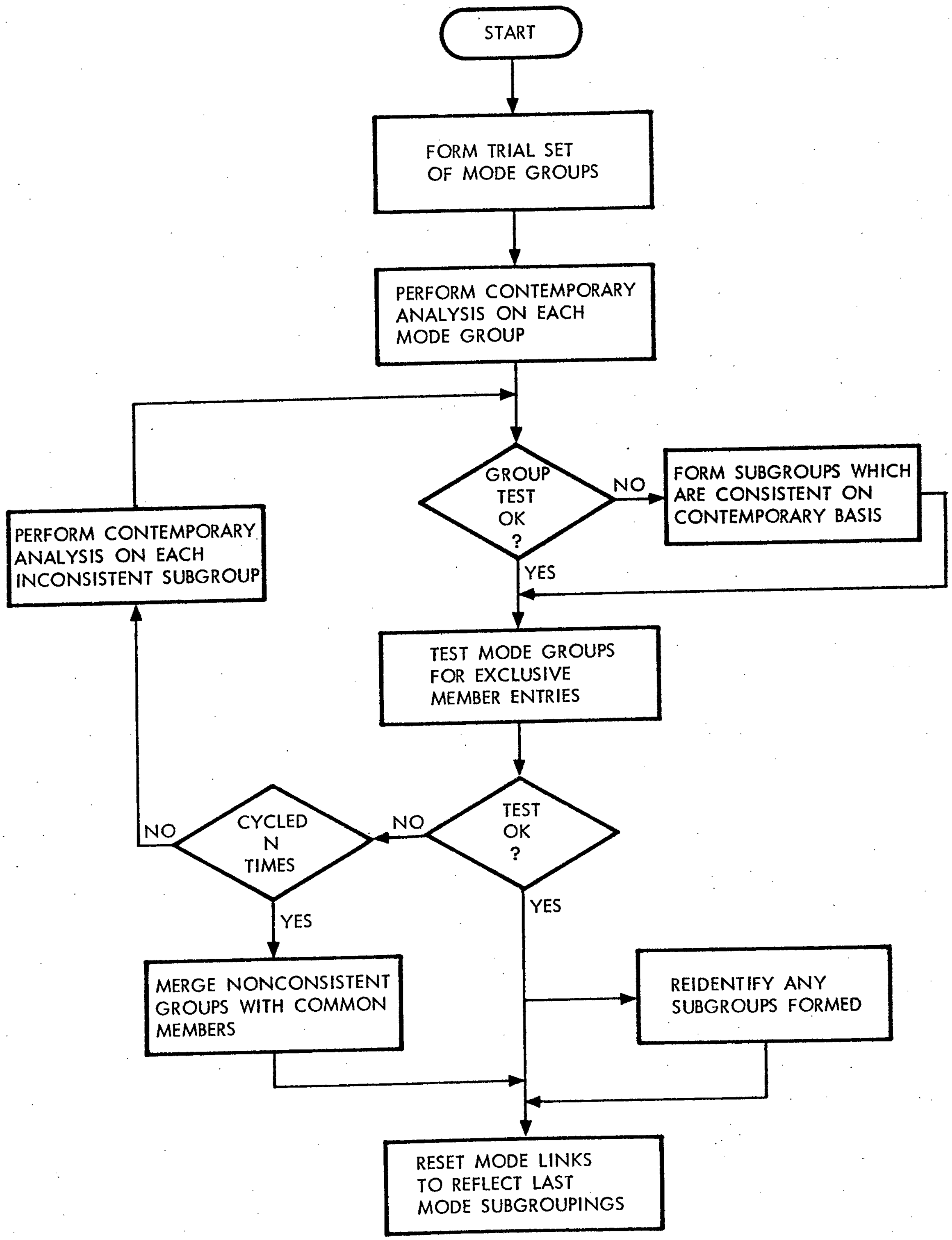

Figure 19. Mode Link Analysis Logic Flow Diagram

3.3.3.3.2.4.2 New Emitter Candidate Mode Groups. The analysis for a new emitter shall be initiated by forming a set of trial mode groups. These sets shall be generated by the following sequence:

1) locate all existing mode groups which include members in the new emitter azimuth cell or an adjacent azimuth cell, and
2) add the new emitter to each group so located.

The set of mode groups are those analyzed using the mode link algorithm in 3.3.3.3.2.4.1

3.3.3.3.2.4.3 Update Emitter Candidate Mode Groups. The analysis of emitters as part of an update cycle shall determine if the existing groups can be partitioned as a result of azimuth change. The azimuth locations of all emitters in the group, including the updated emitter shall be examined to determine if a contiguous set of azimuth cells are occupied. If a gap is detected, the original group shall be partitioned into two subgroups forming contiguous azimuth cells. The original group or the resultant subgroups are then analyzed using the mode link algorithm.

3.3.3.3.2.4.4 Deleted Emitter. The logic sequence to delete emitters shall be as shown in figure 19. When an emitter track file is deleted, the remaining group, if any, shall be analyzed for possible impact. The process required shall be to test the azimuth value of the emitters remaining in the group and to determine if the deleted emitter caused a gap to appear in the formerly contiguous azimuth cell occupancy of the group. If such a gap appears, two subgroups shall be formed each consisting of a set of contiguous azimuth cells. If the mode groups were modified, the emitter track file link fields shall be updated.

3.3.3.3.2.5 Platform Link. The platform link shall group all ETF entries that are contained in one or more of the groups formed by the agile, correlated, or mode link structures. Each time a change occurs in one of the agile, correlated, or mode groups, the platform group shall be updated accordingly. If the platform link changes as the result of any subgroup formation, the members of each platform subgroup shall be reidentified.

3.3.3.3.3 Link Analysis Module Outputs

In the case of new emitter processing, a perform-association message shall be sent to the family association module. If the input emitter is an update or a deletion, no message shall be sent to the family association module. In the cases of new emitter or update processing, an identification message shall be generated if the correlation status of an emitter changes or if a new mode subgroup has been formed. The output messages for the link analysis module shall be as given in table 17.

3.3.3.4 Family Association

The family association (FA) module shall reduce the size of the candidate list by deciding which candidates are associated with other emitters at the same azimuth. The family association shall be done for each candidate in the candidate list. The FA module shall determine if any candidates have common identification with other emitters at the same azimuth. If such a relationship is found, the candidate shall be designated family associated. Candidates with family association shall be retained whereas candidates without family association shall be discarded.

3.3.3.4.1 Family Association Module Inputs

The inputs to the family association module are given in table 18.

Table 17. Link Analysis Module Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Perform Association EFN Pointer	Family Association	Prog Sequence		1 word		
2	Identification Message EFN	Level 1 Search	Prog Sequence		1 word		
3	PDW Analysis Request EFNs Contemporaneous	ABI Management	Prog Sequence		3 words		
4	ALNK CLNK MLNK PLNK FLNK BLNK	Emitter Track File	Data File Store		3 words		

Table 18. Family Association Module Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Perform Association EFN Pointer	Link Analysis or Level 1 Search (CW Processing)	Prog Sequence		1 word		
2	ELN	Candidate List	Data File Access		1 word		
3	CLNK FLNK REID AZ ELN MF CW PITYP MDE	Emitter Track File	Data File Access		4 words		
4	IDENT CORR	Emitter Library	Data File Access		2 words		

3.3.3.4.2 Family Association Module Processing

The FA module shall follow the logical sequence given in figure 20. The FA module shall accept the EFN of the IE to be processed. The IE shall be checked to determine if it is a CW emitter. If not, the FA module shall regenerate the candidate list for the remaining members of the platform link group. Scan type and scan period values required for the level 2 search shall be obtained from the emitter track file rather than from the scan analysis routine.

The FA module shall compare the identification (IDENT) code of each candidate for the IE with the IDENT codes of each candidate for each emitter in the platform group. If at least one of the candidates of the IE matches an IDENT with all of the platform linked emitters, IE candidates with no IDENT matches shall be discarded. If no IE candidate matches all the platform linked emitters, then the candidate list shall remain unchanged. The FA module shall send a message to the ambiguity resolution module to perform a weight decision for the IE and shall then exit.

If the IE is CW, the FA module shall regenerate the candidate list for all the emitters in the same azimuth cell as the IE and in the ±1 adjacent azimuth cells. The requests for PDW analysis and link analysis shall be nullified for each of the above azimuth emitters. The FA module shall compare the IDENT code of each IE candidate with the IDENT codes of each candidate for each emitter in the azimuth cell. If at least one of the candidates of the IE matches an IDENT with at least one of the azimuth emitters, then IE candidates with no IDENT matches shall be discarded. If no matches occur, the candidate list for the IE shall remain unchanged. The FA module shall send a message to the ambiguity resolution module to perform a weight decision for the IE and shall then exit.

3.3.3.4.3 Family Association Module Outputs

The outputs from the family association module shall be as given in table 19.

3.3.3.5 Ambiguity Resolution

The ambiguity resolution (AR) module shall make the unique identification of an emitter. The candidate list which remains after all previous identification has been performed shall be reduced to a single entry by choosing that candidate with the highest weighting factor. The AR module shall then notify the response assessment module that the emitter has been updated.

3.3.3.5.1 Ambiguity Resolution Module Inputs

The inputs to the ambiguity resolution module are given in table 20.

3.3.3.5.2 Ambiguity Resolution Module Processing

The AR module shall accept the EFN of the emitter being processed and the candidate list from the family association module. The AR module shall extract the weighting factors for each candidate from the emitter library, and shall determine the maximum value of the weighting factors. It shall then flag those candidates with the maximum value. The candidates without flags shall be deleted from the candidate list. If more than one candidate has the same maximum weighting factor, the AR module shall choose the candidate with the smallest ELN as the unique identification. The AR module shall update the ETF with the ELN of the chosen candidate.

If the identification of the emitter being processed would affect the identification of the platform-linked emitters, the AR module shall update the platform-linked emitters with a new identification. This will happen in one of two ways: either all the platform-linked emitters shall assume a new identification code which is the same for all, or the emitter being processed

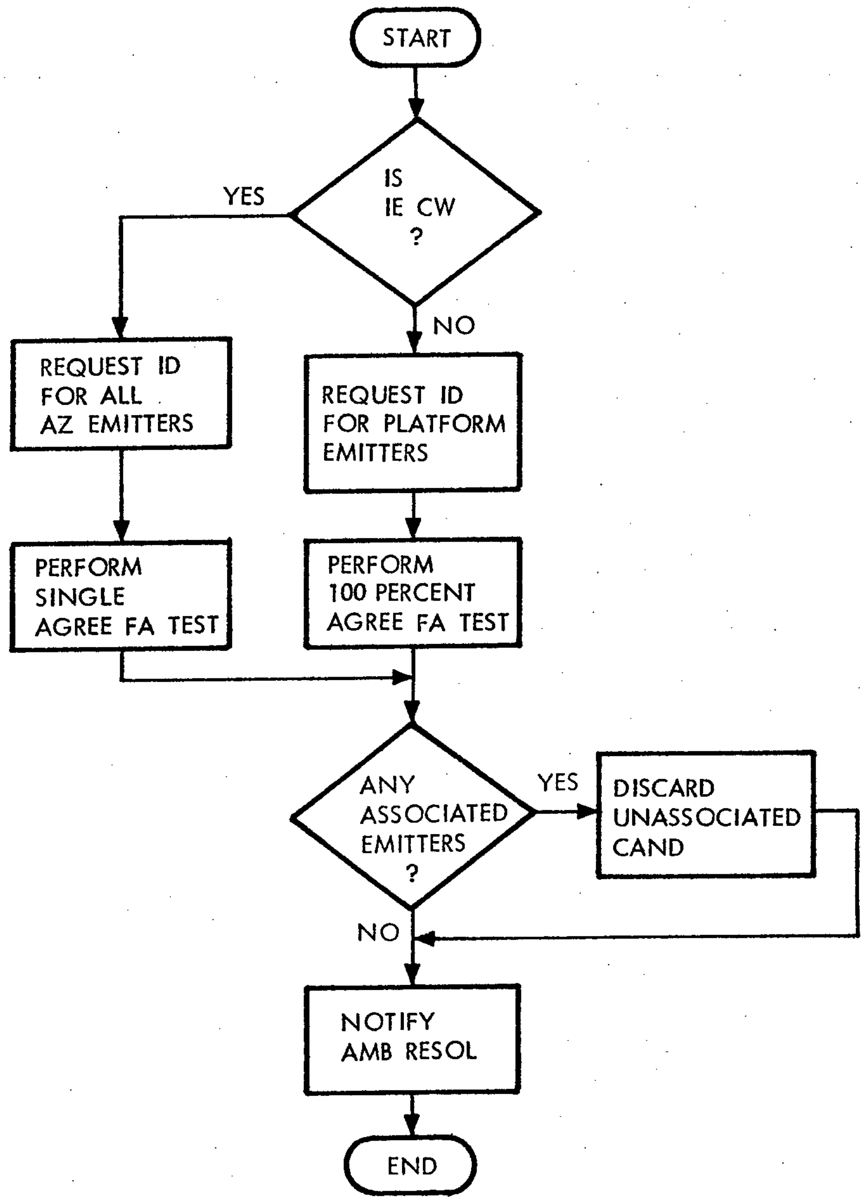

Figure 20. Family Association Logic Flow Diagram

Table 19. Family Association Module Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Perform Weight Decision EFN Pointer	Ambiguity Resolution	Prog Sequence		1 word		
2	Identification Message EFN	Level 1 Search	Prog Output		1 word		
3	Delete ELN	Candidate List	Data File Output		1 word		
4	REID SM ELN DISP	Emitter Track File	Data File Output		2 words		

Table 20. Ambiguity Resolution Module Inputs

ITEM	TASK / DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Perform Weight Decision EFN Pointer	Family Association	Prog Sequence		1 word		
2	ELN	Candidate List	Data File Access		1 word		
3	Weight	Emitter Library	Data File Access		1 word		
4	ELN	Emitter Track File	Data File Access		1 word		

shall be given a different identification from the rest of the platform-linked emitters. In the latter case, each platform-linked emitter shall be reidentified singly on the basis of a weighting factor decision. The AR module shall send an update message to the resource assessment module for each emitter that is updated. The AR module shall then exit.

3.3.3.5.3 Ambiguity Resolution Module Outputs

The outputs from the ambiguity resolution module shall be as given in table 21.

3.3.4 RESOURCE MANAGEMENT FUNCTION

The resource management function shall determine whether each emitter constitutes a threat, and if so, a response shall be determined. This function shall assign a lethality to each threat emitter based on the degree of threat to the IEWS airframe. The emitters shall then be ordered by lethality and resources shall be assigned. Where resources are limited, the emitters of higher lethality shall be assigned those resources preferentially. Each request for a response shall have associated with it three techniques denoted (according to effectiveness) by primary, secondary, and tertiary. This function shall assign the response of highest probable effectiveness to each emitter consistent with resource limitations. The function shall also initiate, monitor, and terminate the operation of the ET, technique generator (TG), and other units. This function shall also control operation of the SS auxiliary bus for ET and TG data. This function shall calculate the VCO utilization factor, shall assign channels and special technique generators on the basis of function and availability, and shall pass necessary parameters to the units mentioned above.

3.3.4.1 Priority Assignment

The priority assignment function shall assign to each ETF number a lethality, and shall maintain a priority file in which all threat ETF numbers are ordered by lethality. The ordinal position of an entry in the priority file shall be its priority.

3.3.4.1.1 Priority Assignment Inputs

The inputs to the priority assignment are given in table 22.

3.3.4.1.2 Priority Assignment Processing

The resource management function shall assign to each ETF entry a lethality whenever an ETF update message is received for that entry. This function shall maintain a list of threat ETF ordered entries by lethality (priority file). Whenever the updated lethality of an ETF entry is different than the previous value of lethality for that ETF entry, the priority list shall be reordered accordingly.

3.3.4.1.2.1 Lethality. Whenever an ETF update message is received, the lethality of the designated ETF entry shall be calculated as follows:

$$L = I + F_j \text{ (altitude)} + G_k \text{ (bearing)} + H_l \text{ (max ampl)}$$

where L is equal to the lethality of the emitter and I, j, k, and l shall be found in the appropriate emitter library entry as FNA, FNB, FNC, and FND, respectively. The parameter j shall designate one of 16 functions of aircraft altitude. Each of these functions shall have a 4-bit argument and a 4-bit value. Similarly, k shall designate one of 16 functions of emitter bearing, and l shall designate one of 16 functions of emitter maximum amplitude. The argument of each function shall be the four MSBs of the designated data. These functions will be defined so that emitters which pose a greater threat to the survival of the aircraft will have a greater lethality. If L is not greater than some threshold T, then L shall be set equal to 0. Every ETF

Table 21. Ambiguity Resolution Module Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Update Message EFN	Resource Assessment	Prog Sequence		1 word		
2	ELN DISP IDENT	Emitter Track File	Data File Store		1 word		

Table 22. Priority Assignment Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Priority Override/ ETF No. Priority	Operator Commands Function	Prog Sequence	None	1 word	ea. Operator Override	
2	ETF Update/ ETF No.	Classification Function	Prog Sequence	None	1 word	ea. ETF Update	
3	Lethality	ETF	Data File Access	None	6 bits	2/ETF Update	
4	Max Amp	ETF	Data File Access	None	5 bits		
5	Azimuth	ETF	Data File Access	None	8 bits	ea. ETF Update	
6	Tech. Source	ETF	Data File Access	None	1 bit	ea. Lethality Change	
7	FNA	EL	Data File Access	None	4 bits	ea. ETF Update	
8	FNB	EL	Data File Access	None	4 bits		
9	FNC	EL	Data File Access	None	4 bits		
10	FND	EL	Data File Access	None	4 bits		
11	ETF No.	PF	Data File Access	None	7 bits	ea. Lethality Change	
12	Channel No.	PF	Data File Access	None	5 bits		
13	Priority Source	PF	Data File Access	None	1 bit		
14	Altitude	INS File	Data File Access	None	4 bits	ea. ETF Update	

entry with nonzero lethality shall be considered a threat. Each newly determined lethality shall be compared to the old lethality (from the ETF). If the two are different, the new lethality shall be written into the ETF and the priority list shall be reordered.

3.3.4.1.2.2 Priority. The resource management function shall maintain a file (priority list) of threat ETF entries (lethality $\neq 0$). The entries in this file shall at all times be ordered by decreasing lethality except as described below. Access to this file shall be by ordinal position (priority). This priority list shall be reordered whenever the lethality of an emitter changes and it does not have an operator assigned priority. The priority list shall also be reordered whenever this function receives a priority override message. The latter will occur whenever the operator wishes to assign the priority of an ETF entry. When a priority override message is received, this function shall set priority source equal to operator for the designated ETF entry and shall reorder the priority list so that the priority of the designated ETF entry shall be that specified. The ETF entry shall remain at that priority until it is again modified by the operator or until the operator returns the priority of that ETF entry to control of this function. When control is returned to this function (by another priority override message), priority source shall be set equal to SC for the designated ETF entry and the priority of the ETF entry shall again be determined only by lethality.

When an auto return message is received from the operator commands function, the priority of all ETF entries shall be returned to this function.

If the update of an ETF entry causes it to have a lethality equal to that of another ETF entry, the priority list shall be reordered so that the priority of the latter ETF entry is unchanged. The priority of the former ETF entry shall be one above or below the priority of the latter so that the relative priorities of both are the same as before the update. If a priority override message causes an ETF entry to be assigned a priority previously assigned to another ETF entry (and not returned to computer control), then the latter ETF entry shall be assigned a priority one below that of the former, and the priority file shall be reordered accordingly.

3.3.4.1.3 Priority Assignment Outputs

The outputs for the priority assignment function shall be as given in table 23.

3.3.4.2 Technique Option Selection

The technique option selection function shall select a technique number for each of three options for each threat ETF entry (lethality $\neq 0$). The technique number chosen for each option shall, in general, be a function of the emitter, frequency quality, PRI range, and max ampl.

3.3.4.2.1 Technique Option Selection Inputs

The inputs to the technique option selection function are given in table 24.

3.3.4.2.2 Technique Option Selection Processing

Whenever an update message is received for a threat ETF entry (lethality > 0) whose technique is not under operator control (technique source = operator), then this function shall determine a technique number for each of three response options (primary, secondary, tertiary) for the designated ETF entry. The emitter library shall contain a basic technique number for each of the three options (basic technique 1, 2, or 3). A small integer shall be added to the basic technique number whenever the parameters of the designated ETF entry meet one of several tests. Failure to meet certain of these tests shall cause this function to designate no valid technique for that option. Those tests, and their associated test values, when necessary, shall be specified in a table at a location specified by technique data 1, 2, and 3 for the primary, secondary, and tertiary options, respectively. The parameters that

Table 23. Priority Assignment Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Priority Reorder/Priority New Priority or ETF No. Op Code	Res Assess Function			1 word	ea. PF re-ordering	
2	Lethality	ETF	Data File Access		6 bits	ea. Lethality Change	
3	ETF No.	PF	Data File Access		7 bits	ea. PF re-ordering	
4	Channel No.	PF	Data File Access		5 bits	ea. PF re-ordering	
5	Priority Source	PF	Data File Access		1 bit	ea. PF re-ordering	

Table 24. Technique Option Selection Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Update/ETF No.	Classification Function		None	1 word	ea. ETF Threat Update under SC Control	
2	Tech Source EL No.	ETF	Data Access File	None	8 bits	ea. Update	
3	Primary Tech	ETF	Data Access File	None	7 bits	ea. Update	
4	Secondary Tech	ETF	Data Access File	None	7 bits	ea. Update	
5	Tertiary Tech	ETF	Data Access File	None	7 bits	ea. Update	
6	Max Amp	ETF	Data Access File	None	5 bits	ea. Update	
7	PRI Range	ETF	Data Access File	None	8 bits	ea. Update	
8	Freq Quality	ETF	Data Access File	None	4 bits	ea. Update	
9	Lethality	ETF	Data File Access	None	6 bits	ea. Update	
10	Mode Link	ETF	Data File Access	None	7 bits	ea. Update	
11	Basic Tech 1	EL	Data File Access	None	7 bits	ea. Update	
12	Basic Tech 2	EL	Data File Access	None	7 bits	ea. Update	
13	Basic Tech 3	EL	Data File Access	None	7 bits	ea. Update	
14	Tech Data 1	EL	Data File Access	None	4 bits	ea. Update	
15	Tech Data 2	EL	Data File Access	None	4 bits	ea. Update	
16	Tech Data 3	EL	Data File Access	None	4 bits	ea. Update	
17	PR Tracker Req	TL	Data File Access	None	2	ea. Update	

may be tested (none, some, or all) shall be max ampl, PRI range, and frequency quality. Details of the process for the selection of each of the three options are shown in figure 21. Whenever any of the three options is changed due to an update by this function, an option change message shall be sent to the resource assessment function.

3.3.4.2.2.1 Maximum Amplitude. Whenever this test is to be performed, the max ampl of the ETF entry shall be compared to TBD. If the former is less than the latter, the technique number shall be increased accordingly. When the designated ETF entry is mode-linked to other ETF entries, this test shall be made with the largest max ampl in the chain.

3.3.4.2.2.2 PRI Range. Whenever the PRI range test is to be performed, the PRI range of the ETF entry shall be compared to two values in the data table. If PRI range lies below the highest value in the data table, the technique number shall be increased accordingly. If the PRI range lies above the highest value, this function shall declare no valid technique for the option under test.

3.3.4.2.2.3 Frequency Quality. Whenever the frequency quality test is to be performed (if and only if the PRI range test is performed), the frequency quality shall be compared to two values in the data table. If frequency quality lies below the highest value in the data table, the technique number shall be increased. If the frequency quality lies above the highest value, this function shall declare no valid technique for the option under test.

3.3.4.2.3 Technique Option Selection Outputs

The outputs from the technique selection function shall be as given in table 25.

3.3.4.3 Resource Assessment

The resource assessment function shall maintain resource assignments. At any time, emitters of higher lethality shall have preferential access to limited resources, and shall be assigned the most effective of the three designated responses consistent with those resource preferences.

3.3.4.3.1 Resource Assessment Inputs

The inputs to the resource assessment function are given in table 26.

3.3.4.3.2 Resource Assessment Processing

Whenever an update of an ETF entry occurs, the VCO utilization factor of that ETF entry must be recalculated. Whenever an option change or priority change message is received, an attempt shall be made to assign (or reassign) ECM responses to some of the ETF entries.

3.3.4.3.2.1 VCO Utilization Factor. The VCO utilization factor shall be recalculated for an ETF entry whenever an ETF update message is received for that ETF entry in order to determine when there is a change in available or required resources. The VCO utilization factor shall be equal to the VCO cycle time (technique library) divided by the average PRI (ETF). The VCO cycle time shall be read from the technique library entry either for the technique currently in use (option number) or for the primary technique, if none is in use (no response). If the newly calculated VCO utilization factor is less than that currently stored in the ETF, this function shall treat this ETF entry as a new entry and store the new value of VCO utilization factor. That is, this function shall attempt to assign the primary technique (if not already assigned). If the primary technique is in use, all entries of lower priority shall be tested for reassignment. If the primary technique cannot be assigned (because of overloaded resources), this function shall attempt to assign the secondary technique, and if that fails, the tertiary technique. If the

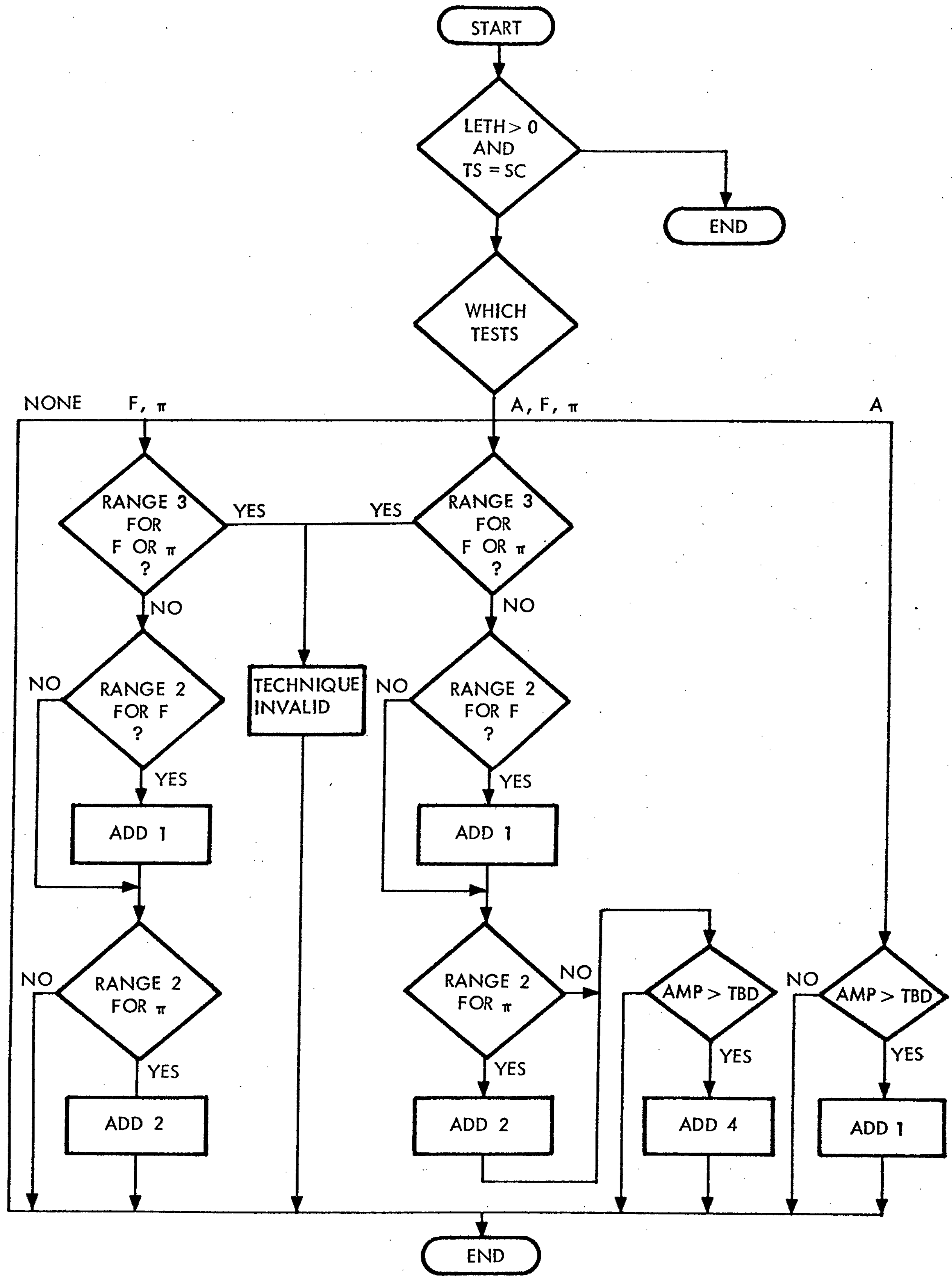

Figure 21. Option Selection Logic Flow Diagram

Table 25. Technique Option Selection Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Option Change/ETF No.	Res Assess Function			1 word	ea. Option Change	
2	Basic Tech 1	ETF	Data File Access		7 bits	ea. Option Change	
3	Basic Tech 2	ETF	Data File Access		7 bits	ea. Option Change	
4	Basic Tech 3	ETF	Data File Access		7 bits	ea. Option Change	

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Table 26. Resource Assessment Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Priority Reorder/etf old priority op code	Priority Function		None	1 word	ea. priority reorder	
2	ETF Update/etf no	Class Function		None	1 word	ea. ETF change	
3	Option Change/etf no.	Option Assign Function		None	1 word	ea. option change	
4	Tech. Override etf no.	Operator Command Function		None	1 word	change as required	
5	PRI Range	ETF	Data File Access	None	8 bits	ea. ETF update	
6	Primary Tech	ETF	Data File Access	None	7 bits	ea. ETF update	
7	Secondary Tech.	ETF	Data File Access	None	7 bits	ea. ETF update	
8	Tertiary Tech	ETF	Data File Access	None	7 bits	ea. ETF update	
9	Utilization Factor	ETF	Data File Access	None	4 bits	ea. ETF update	
10	EL No.	ETF	Data File Access	None	8 bits	ea. ETF update	
11	Mode Link	ETF	Data File Access	None	7 bits	ea. ETF update	
12	Correlate Link	ETF	Data File Access	None	7 bits	ea. ETF update	
13	Offset	ETF	Data File Access	None	3 bits	ea. ETF update	
14	Avg PRI	ETF	Data File Access	None	14 bits	ea. ETF update	
15	Tracker Type	ETF	Data File Access	None	2 bits	ea. ETF update	
16	Gen No. a	JSF	Data File Access	None	2 bits	ea. assignment	
17	Gen No. b	JSF	Data File Access	None	2 bits	ea. assignment	
18	Gen No. c	JSF	Data File Access	None	2 bits	ea. assignment	
19	Gen No. d	JSF	Data File Access	None	3 bits	ea. assignment	
20	Tech Source	JSF	Data File Access	None	2 bits	ea. assignment	
21	Prelim Tracker	EL	Data File Access	None	2 bits	ea. ETF update	
22	CW	EL	Data File Access	None	1 bit	ea. ETF update	
23	Primary Tracker Required	TL	Data File Access	None	1 bit	ea. ETF update	
24	Spec Gen Required	TL	Data File Access	None	4 bits	ea. ETF update	
25	VCO Cycle Time	TL	Data File Access	None	4 bits	ea. ETF update	
26	Channels	RF	Data File Access	None	8 bits	ea. priority change	
27	Gen No. a	RF	Data File Access	None	3 bits	ea. priority change	

Table 26. Resource Assessment Inputs (concl)

ITEM	TASK / DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
28	Gen No. b	RF	Data File Access	None	3 bits	ea. priority change	
29	Gen No. c	RF	Data File Access	None	3 bits	ea. priority change	
30	Gen No. d	RF	Data File Access	None	7 bits	ea. priority change	
31	Max Mult Freq	RF	Data File Access	None	2 bits	ea. priority change	
32	Mult Freq Prevent	RF	Data File Access	None	4 bits	ea. priority change	
33	Total Util. Factor	RF	Data File Access	None	7 bits	ea. priority change	
34	CW Present	RF	Data File Access	None	1 bit	ea. priority change	
35	Max MF Present	RF	Data File Access	None	4 bits	ea. priority change	

newly calculated VCO utilization factor is greater than that currently stored in the ETF, the current technique assignment shall be tested to insure that is not overloading resources, and the new value of VCO utilization factor shall be stored. The VCO utilization factor shall also be calculated whenever a technique is tested (for resource overload) and is not the technique on which the currently stored VCO utilization factor is based.

3.3.4.3.2.2 Technique Assignment. When VCO duty cycle changes or when one of the following messages occur, the resource management function shall reassign responses accordingly:

1) priority change,
2) option change, or
3) technique override.

Each possible new assignment shall be tested for each of three possible resource overload conditions. If the assignment of the primary response would produce a resource overload, resources shall be taken away from lower priority ETF entries, if possible, so that the overload will not occur. If lower priority ETF entries do not have adequate resources for the new assignment, the ETF entry shall be similarly tested for the possibility of assignment of a secondary response. If that response would also cause a resource overload, the ETF entry shall be assigned its tertiary response. This process is illustrated in more detail in figure 22. Generally, the first ETF entry considered shall be the designated entry and if a change in assignments occurs, more ETF entries shall be tested as shown in figure 23. If, however, an ETF entry is deleted (as indicated in a priority change message), the response shall be terminated and other ETF entries shall also be tested as shown in figure 23. If a priority change message indicates an ETF entry has been moved down, all entries between (and including) the old and new priority shall be tested. If a change of assignments occur due to these tests, more ETF entries shall be tested as indicated in figure 23. Generally, whenever resources are made available, all ETF entries of lower priority shall be tested. Whenever resources are taken away from an ETF entry, then that entry and all entries of lower priority shall be tested. The resource file shall indicate which resources are available.

Whenever a new assignment is made, a reassign technique message shall be sent to the resource assignment function (Refer to 3.3.4.4.) and the engaged bit shall be set in the appropriate ETF entry. Whenever an assignment is deleted, a reassign technique message shall be sent to the resource assignment function and the engaged bit shall be reset in the appropriate ETF entry.

The following are the resources whose usage must be monitored to insure that they are not overloaded:

1) VCOs,
2) special generators, and
3) pulse delay module (PDM) trackers.

3.3.4.3.2.2.1 VCO Monitoring. VCO assignments shall be monitored to assure that the limited number of VCOs can accommodate assigned responses. Occasionally, a response to an individual pulse may not occur because all VCOs are in use. However, the number of such missed responses shall be limited by limiting the assignment of techniques requiring a VCO. Usage of VCOs shall be monitored primarily through use of the total utilization factor. The total utilization factor shall be equal to the sum of the VCO utilization factors of the relevent emitters. The VCO utilization factor of each emitter shall be obtained from the ETF and shall give the fraction of time that a given response for a given emitter requires VCO use. The VCO resources shall

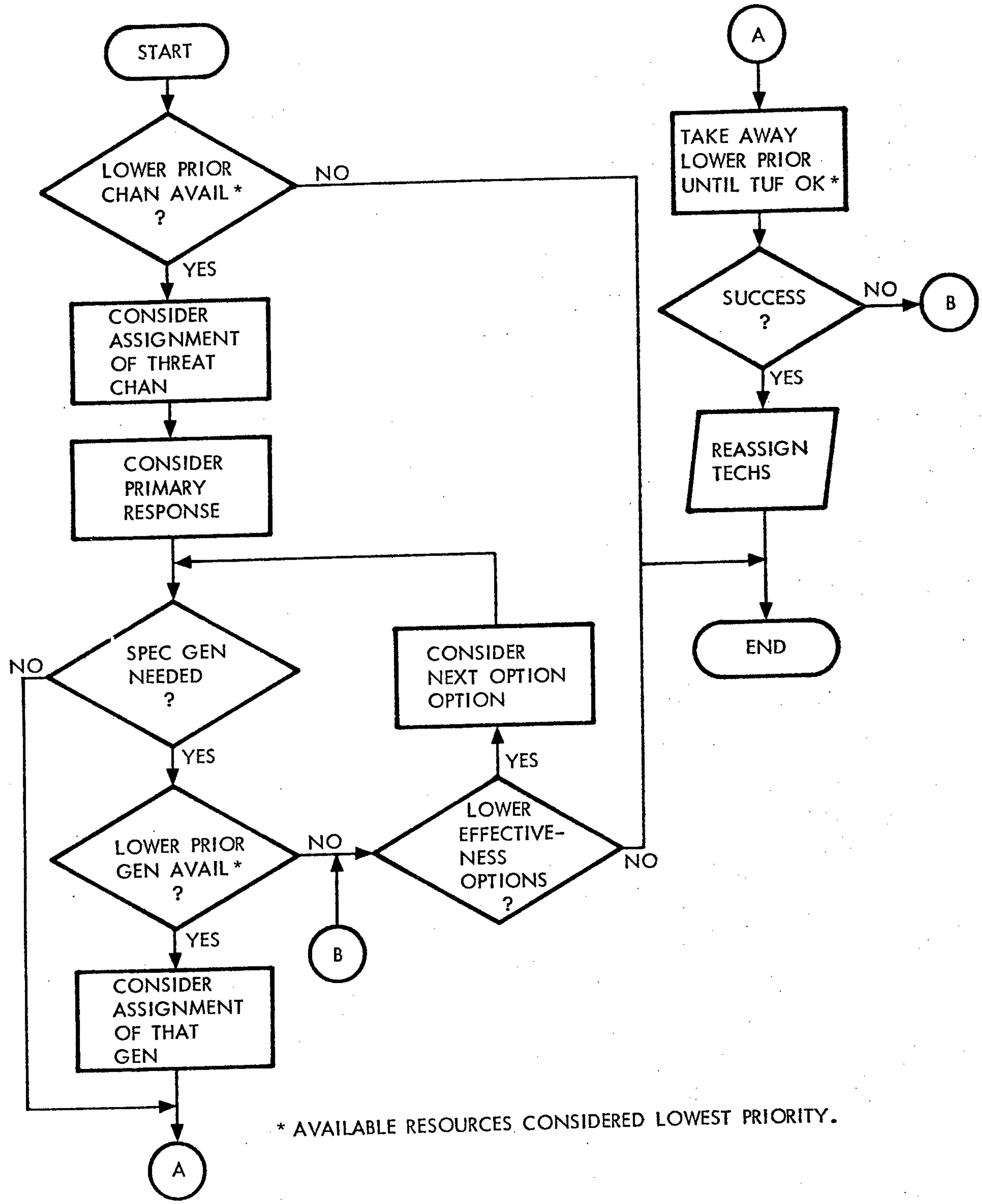


Figure 22. Resource Assessment Logic Flow Diagram

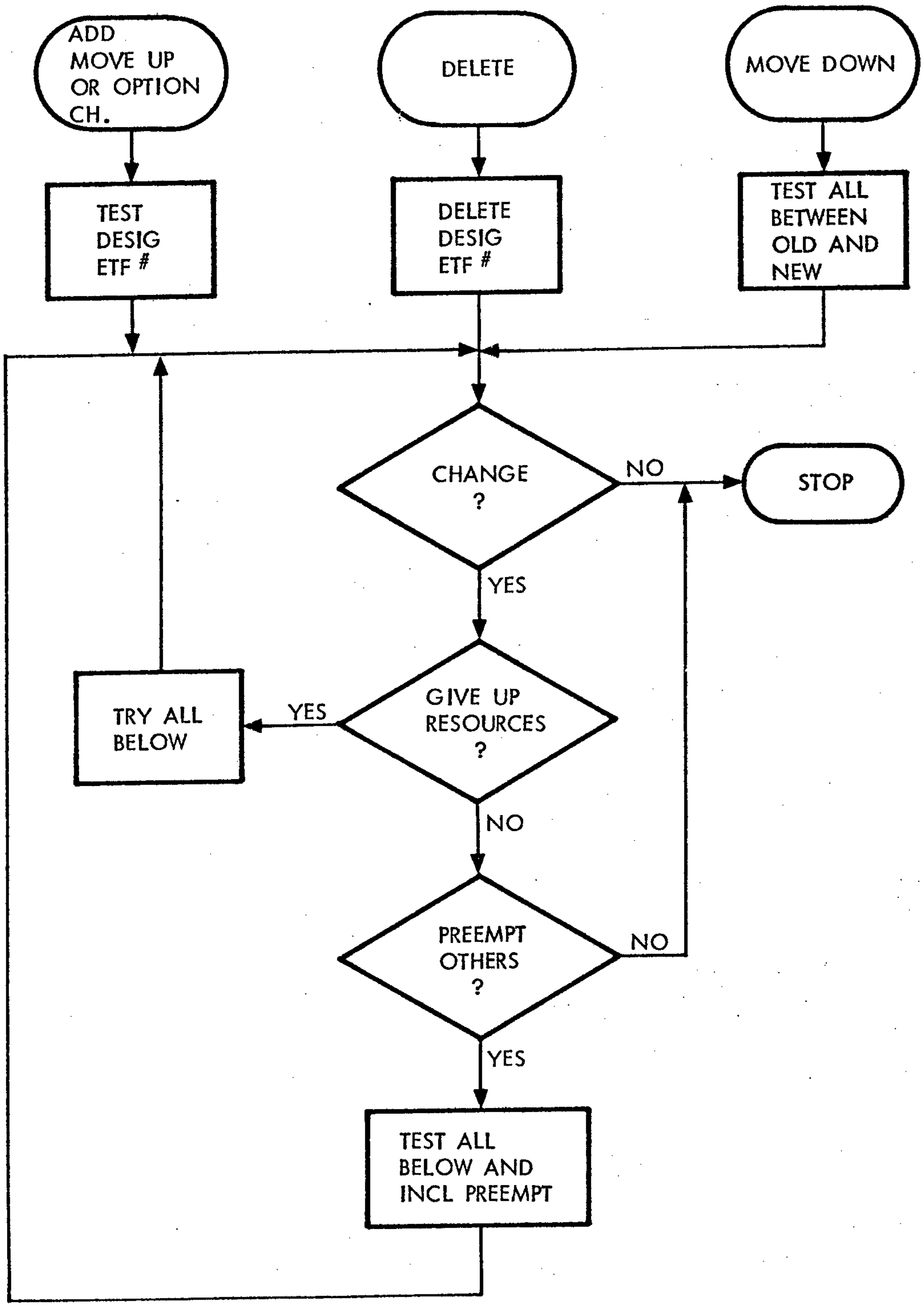


Figure 23. ETFs Tested Logic Flow Diagram

an Emitter Tracker channel number shall be assigned. If the Tracker Type designated for the assigned technique is Primary, then one of channels 0-7 shall be assigned. If the Tracker Type is Alternate, then one of channels 10_8-17_8 shall be assigned. If the Tracker Type is Either, then a channel shall be assigned from the group (0-7 or 10-17) which has the least number of channels currently in use, except as noted below.

be considered overloaded when the total utilization factor exceeds the maximum utilization factor. The maximum utilization factor shall be a function of the following variables:

1)	maximum frequencies in one emitter (maximum multiple frequencies),	(1 - 4)
2)	number of multiple frequency emitters (multiple frequencies present),	(0, 1 or >1)
3)	number of emitters, and	(1 or >1)
4)	CW assignments (CW present)	(1 or 0)

The parenthetical names refer to the resource file data.

The maximum utilization factor shall be determined by the value of each of the four variables and, therefore, there shall be 48 possible combinations of these parameters; however, there shall be only eight possible values of maximum utilization factor. The maximum utilization factor shall be an eight-bit number with the LSB = 0.01. A CW response will tie up one VCO continuously and only one CW response using a VCO shall be allowed.

3.3.4.3.2.2.2 Special Generators. Each technique library entry will indicate the requirements for special generators whose numbers are limited. Any of the special generators shall be considered overloaded when the number of special generators required of one type exceeds the number available.

3.3.4.3.2.2.3 PDM Trackers. The PDM trackers shall be considered overloaded when the number of trackers required exceeds the number available.

3.3.4.3.3 Resource Assessment Outputs

The outputs from the resource assessment function shall be as given in table 27.

3.3.4.4 Resource Assignment

The resource management function shall maintain a resource file which shall contain the status of those resources which are limited, such as special generators and response channels. These resources shall be assigned according to function and availability. This function shall also compute parameters to be sent to the emitter tracker as necessary, and shall also maintain the jam station file in which the status of the channels is stored.
status

3.3.4.4.1 Resource Assignment Inputs

The inputs to the resource assignment function are given in table 28.

3.3.4.4.2 Resource Assignment Processing

Whenever a reassign technique message is received, this function shall assign limited resources and shall determine programmable parameters for the following units:

1) emitter tracker,
2) technique generator,
3) signal sorter, and
4) other external devices.

3.3.4.4.2.1 Emitter Tracker. This function shall calculate and code several parameters and shall assign and link trackers as necessary. Whenever a track-dropped interrupt is received, this function shall recalculate parameters for the designated channel and shall reprogram the corresponding tracker.

Table 27. Resource Assessment Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Reassign Tech/Priority Tech Source	Tech Assign Function			1 word	ea. assignment	
2	Utilization Factor	ETF	Data File Access		4 bits	ea. ETF update	
3	Tracker Type	ETF	Data File Access		1 bit	ea. ETF update	
4	Max Mult Freq	RF	Data File Access		2 bits	ea. assignment	
5	Mult Freq Present	RF	Data File Access		4 bits	ea. assignment	
6	Total Util. Factor	RF	Data File Access		7 bits	ea. assignment	
7	CW Present	RF	Data File Access		1 bit	ea. assignment	

Table 28. Resource Assignment Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Reassign Tech/ETF No.	Tech Assess Function		None	1 word	ea. response change	
2	Tech Source Track Dropped	Emitter Tracker Interrupt		None	1 word	as required	
3	Hold Pts/chan no. Poll Period ETF No.	Class. Function		None	1 word	as required	
4	Terminate	De-interleave Function		None	1 word	as required	
5	ETF Update/ETF No.	Class. Function			1 word	ea. update	
6	Avg PRI	ETF	Data File Access	None	14 bits	ea. assignment	
7	PRI Range	ETF	Data File Access	None	8 bits	ea. assignment	
8	Compos. PRI	ETF	Data File Access	None	13 bits	ea. assignment	
9	Scan Freq	ETF	Data File Access	None	13 bits	ea. assignment	
10	Stagger	ETF	Data File Access	None	4 bits	ea. assignment	
11	Primary Tech	ETF	Data File Access	None	7 bits	ea. assignment	
12	Secondary Tech	ETF	Data File Access	None	7 bits	ea. assignment	
13	Tertiary Tech	ETF	Data File Access	None	7 bits	ea. assignment	
14	Mode Link	ETF	Data File Access	None	7 bits	ea. assignment	
15	Cor Link	ETF	Data File Access	None	7 bits	ea. assignment	
16	Offset	ETF	Data File Access	None	3 bits	ea. assignment	
17	EL No.	ETF	Data File Access	None	8 bits	ea. assignment	
18	Channel No.	PF	Data File Access	None	3 bits	ea. assignment	
19	ETF No.	PF	Data File Access	None	7 bits	ea. assignment	
20	Channel	RF	Data File Access	None	8 bits	ea. assignment	
21	Gen No. a	RF	Data File Access	None	3 bits	ea. assignment	
22	Gen No. b	RF	Data File Access	None	3 bits	ea. assignment	
23	Gen No. c	RF	Data File Access	None	3 bits	ea. assignment	
24	Gen No. d	RF	Data File Access	None	7 bits	ea. assignment	
25	Hit Count	EL	Data File Access	None	4 bits	ea. assignment	
26	Gen Required	TL	Data File Access	None	3 bits	ea. assignment	
27	ETF No.	JSF	Data File Access	None	2 bits	ea. assignment	
28	Gen No. a	JSF	Data File Access	None	2 bits	ea. assignment	
29	Gen No. b	JSF	Data File Access	None	2 bits	ea. assignment	

Table 28. Resource Assignment Inputs (concl)

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
30	Gen No. c	JSF	Data File Access	None	2 bits	ea. assignment	
31	Gen No. d	JSF	Data File Access	None	3 bits	ea. assignment	
32	Tech In Use	JSF	Data File Access	None	7 bits	ea. assignment	
33	Tech Source	JSF	Data File Access	None	2 bits	ea. assignment	
34	Link Up	JSF	Data File Access	None	1 bit	ea. assignment	
35	Link Down	JSF	Data File Access	None	1 bit	ea. assignment	
36	Source Chan	JSF	Data File Access	None	1 bit	ea. assignment	
37	External Devices	EL	Data File Access	None	32 bits	ea. ETF update	

3.3.4.4.2.1.1 Parameter Calculation. This function shall calculate delay and gate half width for programming the ET. The delay shall be equal to the composite PRI minus 128 μs. The gate half width shall be calculated as given in table 29.

Table 29. Gate Half Width Calculation

Calculation	Conditions
0.625 R*	Stagger = 1 Pretrigger = Short R ≤ 40 μs
0.625 R	Stagger = 1 Pretrigger = Long R ≤ 80 μs
25 μs	Stagger = 1 Pretrigger = Short R > 40 μs
50 μs	Stagger = 1 Pretrigger = Long R > 80 μs
1 μs	Stagger > 1

* R = PRI range (ETF)

3.3.4.4.2.1.2 Tracker Assignment. Whenever a technique assignment is to be made, the lowest available PDM channel number shall be assigned to the response. A newly assigned response may be linked by simultaneity to another currently assigned response. In that case, ET channel assigned to the new response shall be driven by the tracker in the channel assigned to the old linked response. Whenever a new response is assigned, the ETF shall be searched for a simultaneous engaged ETF entry (as designated by the engaged bit and by a correlated link to the designated ETF entry and the same offset as the designated ETF entry). If one is found, it shall be located in the jam status file. If the located response is already part of a linked set of simultaneous responses, (always adjacent channels, with wrap-around), the new response shall be linked to one end of that chain. Other responses may have to be moved to other channels in order to assign the new response a channel which is adjacent to the end of the chain. Only one channel in such a chain shall be fully programmed. That channel shall be called the source channel. All other channels in the chain shall be programmed only with the link indication. When a response in a chain is deleted, the chain shall be patched accordingly to maintain all links in the chain in adjacent channels. If the one programmed channel is to be deleted, then another channel must be programmed. The details of this programming are shown in figure 24. Whenever a response is terminated, a message shall be sent to the emitter tracker indicating termination of operation for a specified channel number.

The hit count shall be read from the emitter library for the emitter to which a response is being made. This parameter will be equal to eight times the number of pulses expected to be above threshold at maximum response range.

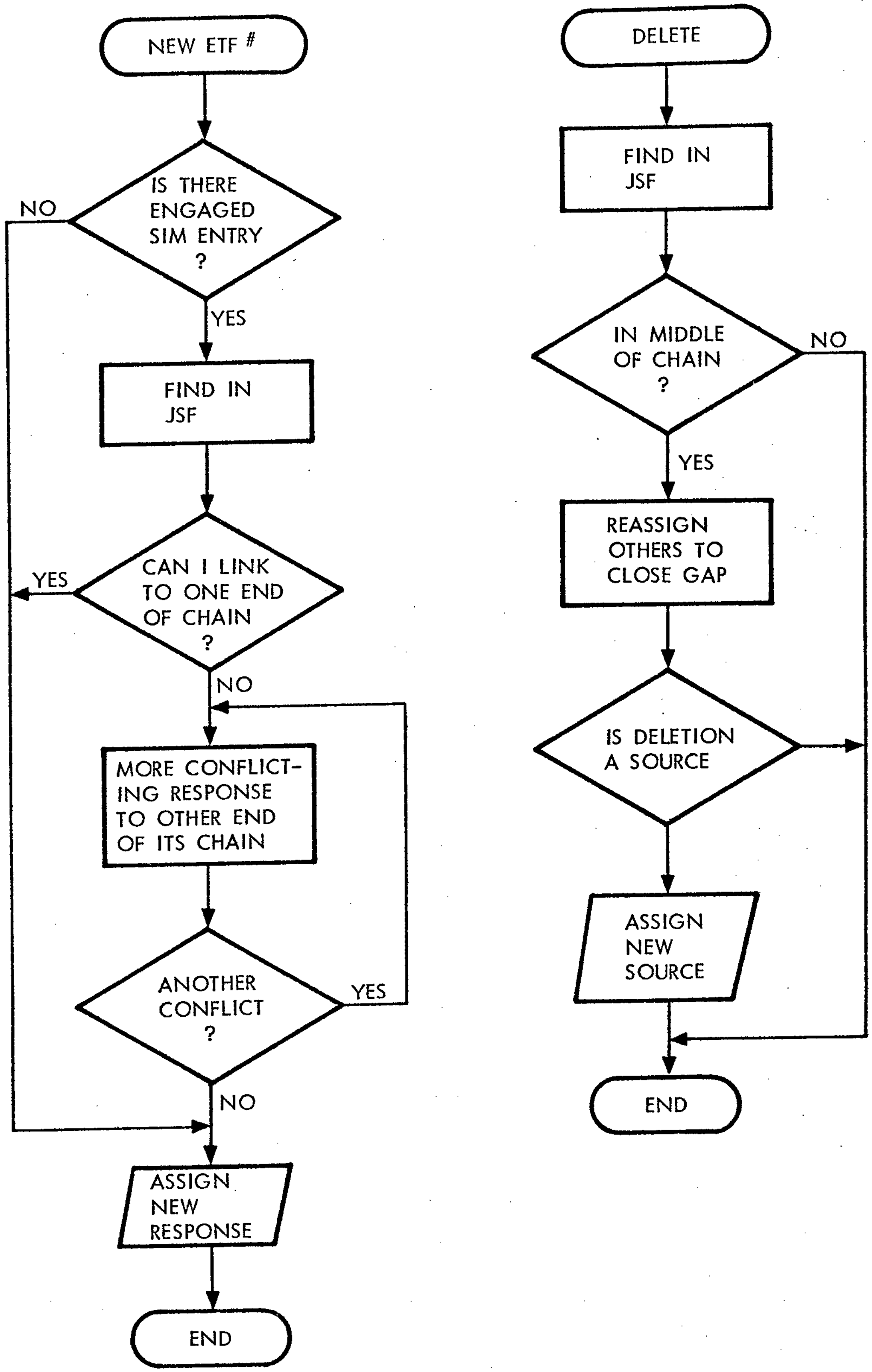


Figure 24. Multiple Frequency Link Maintenance Flow Diagram

3.3.4.4.2.2 Technique Generator. Whenever a technique assignment is to be made, the lowest available special generator type shall be specified by generators required from the technique library. Whenever the channel to be programmed is part of a set of linked simultaneous responses (Refer to 3.3.4.4.2.1.2.), that channel shall be programmed with the frequency of the corresponding ETF entry. Otherwise frequency shall not be programmed.

3.3.4.4.2.3 Signal Sorter. This function shall normally send to the SS the same channel number sent to the ET and to the TG for the same ETF entry. However, whenever the designated ETF entry is linked to another ETF entry by simultaneity (Refer to 3.3.4.4.2.1.2.), this function shall send to the SS the channel number of the source channel of the simultaneous chain. That is, whenever a simultaneous chain of trackers has been assigned, the source channel number shall be sent to the SS for each of the ETF entries in the chain.

3.3.4.4.2.4 Other External Devices. Whenever this function receives an ETF update message from the classification function, the function shall examine the external devices field in the emitter library entry corresponding to the designated ETF entry. The external device field shall contain four pointers and four data entries. The four pointers in this field shall cause the four designated subroutines to be executed. These subroutines will use the four data stored in this field, respectively.

3.3.4.4.3 Resource Assignment Outputs

The outputs from the resource assignment function shall be as given in table 30.

3.3.5 PDW PROCESSING

The PDW processing program shall provide the analysis and overhead associated with the near-real-time data available from the signal sorter's auxiliary bus. The SS will have the capability to transmit PDWs to the SC for a higher-level analysis than the analysis performed by the SS as part of the tracking function. The PDW data will be transferred from the auxiliary bus to a one thousand word buffer memory in the SC under the control of the auxiliary bus interface (ABI). The PDW processing program shall control the operation of the SS and the ABI to select PDWs to be transmitted to the SC. The PDW processing program shall analyze the PDW data to determine scan, frequency, and PRI characteristics and the contemporaneity of signals associated with multiple track files.

The PDW processing program shall operate as shown in figure 25. A requesting module within the operational software shall communicate with the ABI management module to request a PDW analysis. The ABI management module shall set up the signal sorter and the ABI to transfer the requested PDW data to the buffer memory. The ABI management module shall notify the module requesting analysis that the PDW data is available. The analysis module shall accept the data, shall perform the appropriate analysis, and shall return the results of the analysis directly to the requesting module.

3.3.5.1 ABI Management

The ABI management module shall process requests for PDW analysis from other operational program modules. The ABI management module shall control the operation of the SS that selects PDWs to be transmitted over the auxiliary bus. The ABI management module shall control the buffer allocation by the ABI such that PDWs for each EFN are stored in designated buffer areas. The analysis modules shall be notified when data is available and shall be notified to initiate the analysis processing. The ABI management module shall also terminate data flow on the auxiliary bus when the analysis is complete.

3.3.5.1.1 ABI Management Inputs

The inputs to the ABI management module are given in table 31.

Table 30. Resource Assignment Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	PTS Assigned/Chan No.	Deinterleave Function			1 word	When necessary	
2	Link Up	ET	Programmed Output		1 bit	ea. assignment	
3	Link Down	ET	Programmed Output		1 bit	ea. assignment	
4	Acn Selection	ET	Programmed Output		1 bit	ea. assignment	
5	Composite Delay	ET	Programmed Output		13 bits	ea. assignment	
6	Coded Gate Half Width	ET	Programmed Output		7 bits	ea. assignment	
7	Poll Period	ET	Programmed Output		4 bits	ea. assignment	
8	Hit Count	ET	Programmed Output		4 bits	ea. assignment	
9	Stagger	ET	Programmed Output		4 bits	ea. assignment	
10	Chan No.	ET	Programmed Output		5 bits	ea. assignment	
11	Tech No.	TG	Programmed Output		7 bits	ea. assignment	
12	Chan No.	TG	Programmed Output		5 bits	ea. assignment	
13	Spec Gen No.	TG	Programmed Output		9 bits	ea. assignment	
14	ETF No.	SS	Programmed Output		7 bits	ea. assignment	
15	Chan No.	SS	Programmed Output		5 bits	ea. assignment	
16	Chan	RF	Data File Access		8 bits	ea. assignment	
17	Gen No. a	RF	Data File Access		3 bits	ea. assignment	
18	Gen No. b	RF	Data File Access		3 bits	ea. assignment	
19	Gen No. c	RF	Data File Access		3 bits	ea. assignment	
20	Gen No. d	RF	Data File Access		7 bits	ea. assignment	
21	ETF No.	JSF	Data File Access		7 bits	ea. assignment	
22	Gen No. a	JSF	Data File Access		2 bits	ea. assignment	
23	Gen No. b	JSF	Data File Access		2 bits	ea. assignment	
24	Gen No. c	JSF	Data File Access		2 bits	ea. assignment	
25	Gen No. d	JSF	Data File Access		3 bits	ea. assignment	
26	Tech In Use	JSF	Data File Access		2 bits	ea. assignment	
27	Tech Source	JSF	Data File Access		2 bits	ea. assignment	
28	Link Up	JSF	Data File Access		1 bit	ea. assignment	
29	Link Down	JSF	Data File Access		1 bit	ea. assignment	
30	Source Chan	JSF	Data File Access		1 bit	ea. assignment	
31	External Device Instructions	External Device	Programmed Output		-	as necessary	

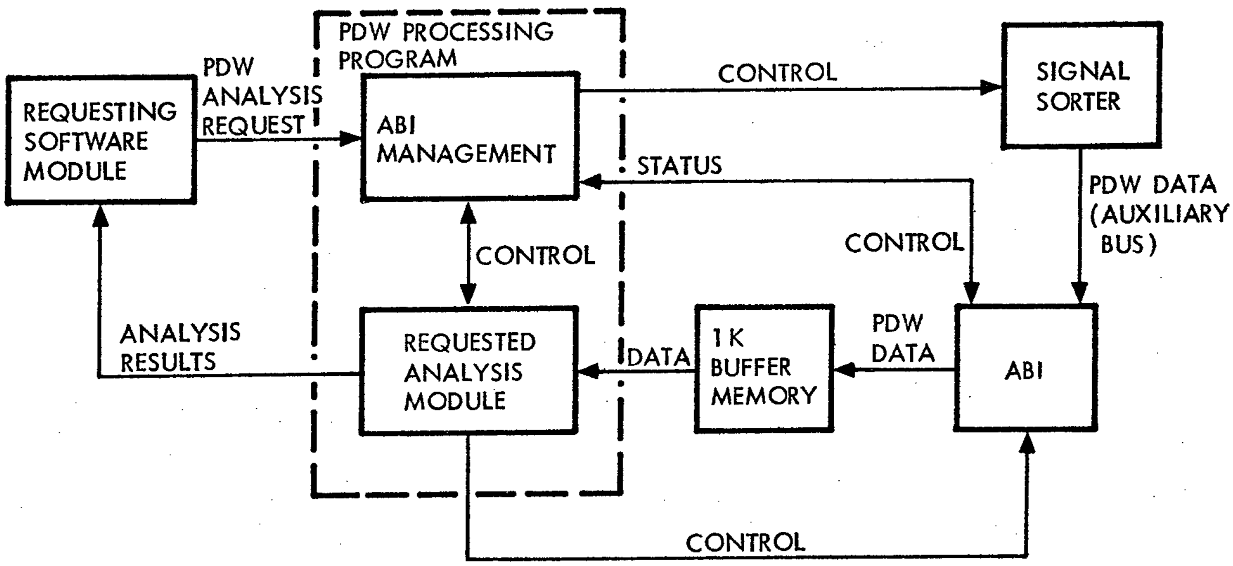


Figure 25. PDW Processing Program Operation

Table 31. ABI Management Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	PDW Analysis Request EFN = SFN Contemporaneous EFNs Scan Bit Freq Bit PRI Bit Contemporaneous Bit US Bit	Data Acq or Level 2 Search or Link Analysis	Prog Sequence		3 words		
2	Buffer N Control Words N = 0, 1 . . . , 15 Int Enab PDW Pointer Status US SFN	Auxiliary Bus Interface	Prog Input		16 words		
3	Interrupt Status Register Bus Busy ABI Data Bus Busy Enable ABI Data Enable	Auxiliary Bus Interface	Prog Input		1 word		
4	Buffer Full Status Register Full Bit n, n = 0, 1, . . . , 15	Auxiliary Bus Interface	Prog Input		1 word		
5	Buffer Done EFN	Scan Analysis or Freq Anal or PRI Anal or Contemporaneous Anal	Prog Sequence		1 word		

3.3.5.1.2 ABI Management Processing

The ABI management module shall accept requests for PDW analysis and shall determine which PDWs are to be transmitted and which analysis module has been requested. PDWs to be transmitted will be in one of two categories:

1) unsorted PDWs, and
2) selected PDWs.

Selected PDWs shall be associated with an EFN which will be identical to the SFN. Unsorted PDWs will be all PDWs which do not associate with any SFN. If selected PDWs are requested, the ABI management module shall designate two 64-word (16-bit) buffer areas for the associated SFN. If unsorted PDWs are requested, N_B buffer areas shall be designated where N_B is a programmable parameter.

The ABI management module shall provide outputs to the SS which shall request unsorted or selected PDWs. If selected PDWs are requested, the signal sorter shall be provided with the following data:

1) SFN = SFN of PDWs to be transmitted,
2) TCODE = 1XXXXXXX = SC designator, and
3) TTAMP = amplitude threshold above which PDWs shall be sent to the SC.

The value of TTAMP will be dependent on the analysis module that is called. The correspondence shall be as follows:

1) scan analysis: TTAMP = $\left[\text{PAMP} + 10_{16}\right]$ 4 MSB,
2) frequency analysis: TTAMP = F_{16},
3) PRI analysis: TTAMP = F16,
4) contemporaneous analysis: TTAMP = F16, and
5) deinterleaving: TTAMP = F16.

The ABI shall be set up to receive the requested PDWs by specifying for each buffer to be used:

1) SFN or unsorted designation,
2) empty buffer status, and
3) ABI interrupt enable.

The ABI management module shall maintain a record of the allocation of buffer areas and shall assign available buffer areas to new requests for PDW analysis.

Each time a 64 word buffer becomes full, the ABI management module receives an interrupt message. The ABI management module shall read the buffer full status register to determine which buffer(s) caused the interrupt. The ABI management module shall determine the analysis module corresponding to the full buffer and shall notify that analysis module to accept data from the buffer.

The ABI management module shall determine the end of data acquisition, when enough PDWs have been received, by either a time-out period or by the number of buffers that have been filled. The criteria for each of the analysis modules shall be as follows:

1) scan analysis – time-out of S_A milliseconds,
2) frequency analysis – F_A buffers,
3) PRI analysis – P_A buffers,
4) contemporaneous analysis – time-out of C_A milliseconds, and
5) deinterleaving – no ABI management requirement,

where S_A, F_A, P_A, and C_A shall be programmable parameters.

At the end of the data acquisition period for a specified analysis, the ABI management module shall notify the corresponding analysis module to commence processing and shall cause the SS to stop sending PDWs to the analysis module. At this time any parameter data required by the analysis module shall be provided. When the analysis module notifies the ABI management module that the data buffers are no longer needed, the ABI management module shall set their status to empty and shall reassign them as required.

3.3.5.1.3 ABI Management Outputs

The outputs from the ABI management module shall be as given in table 32.

3.3.5.2 Scan Analysis

The SA module shall process PDWs for specific ETF entries to determine scan type and scan period. The SA module shall form an amplitude histogram of the received pulses and shall calculate a variance and a mean value for the histogram. On the basis of the ratio of the variance to the mean value the scan type shall be determined to be either steady, conical, sector, or circular scan. The scan period shall be determined by calculating the autocorrelation function of the pulse train and setting the scan period equal to the dominant periodicity that exists in the autocorrelation function.

3.3.5.2.1 Scan Analysis Inputs

The inputs to the scan analysis module are given in table 33.

3.3.5.2.2 Scan Analysis Processing

The SA module shall unload ABI buffers upon command from the ABI management module. For each buffer the SA module shall extract the amplitude and the time-of-arrival (TOA) for each pulse.

The SA module shall build a histogram of the amplitude values obtained. The bin size for the histogram shall correspond to the LSB of the amplitude field, 1.6 dB.

The TOA for each pulse shall be stored to form a TOA array of values that are time ordered.

When the time-out period for pulse reception has been exceeded, the ABI management module shall notify the SA module to commence processing. The SA module shall respond with a buffer-done message. The processing sequence for the SA module shall be as shown in figure 26. The SA module shall determine if any pulses have been received. If no pulses were received, the SA module shall set the scan type to sidelobe, shall notify the level 2 search module, and shall exit. If pulses have been received, the SA module shall continue. The SA module

Table 32. ABI Management Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	SPDW REQUEST SFN TTAMP TCODE	Signal Sorter	Prog Output		2 words		
2	SPDW STOP EFN	Signal Sorter	Prog Output		1 word		
3	UPDWREQUEST	Signal Sorter	Prog Output		1 word		
4	UPDWSTOP	Signal Sorter	Prog Output		1 word		
5	BUFFERN CONTROL WORD N=0, 1, . . . , 15 int enab pdw pointer status ns sfn	Auxiliary Bus Interface	Prog Output		16 words		
6	ABI DATA INTERRUPT DISABLE	Auxiliary Bus Interface	Prog Output		1 word		
7	ABI DATA INTERRUPT ENABLE	Auxiliary Bus Interface	Prog Output		1 word		
8	UNLOAD BUFFER efn buffer number	Any Analysis Module	Prog Sequence		1 word		
9	START PROCESS efn's aupri	Any Analysis Module	Prog Sequence				

Table 33. Scan Analysis Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	UNLOAD BUFFER efn buffer number	ABI Management	Prog Sequence		1 word		
2	START PROCESS efn aupri	ABI Management	Prog Sequence		2 words		
3	AMP TOA	Auxiliary Bus Interface	Prog Input		2 words		

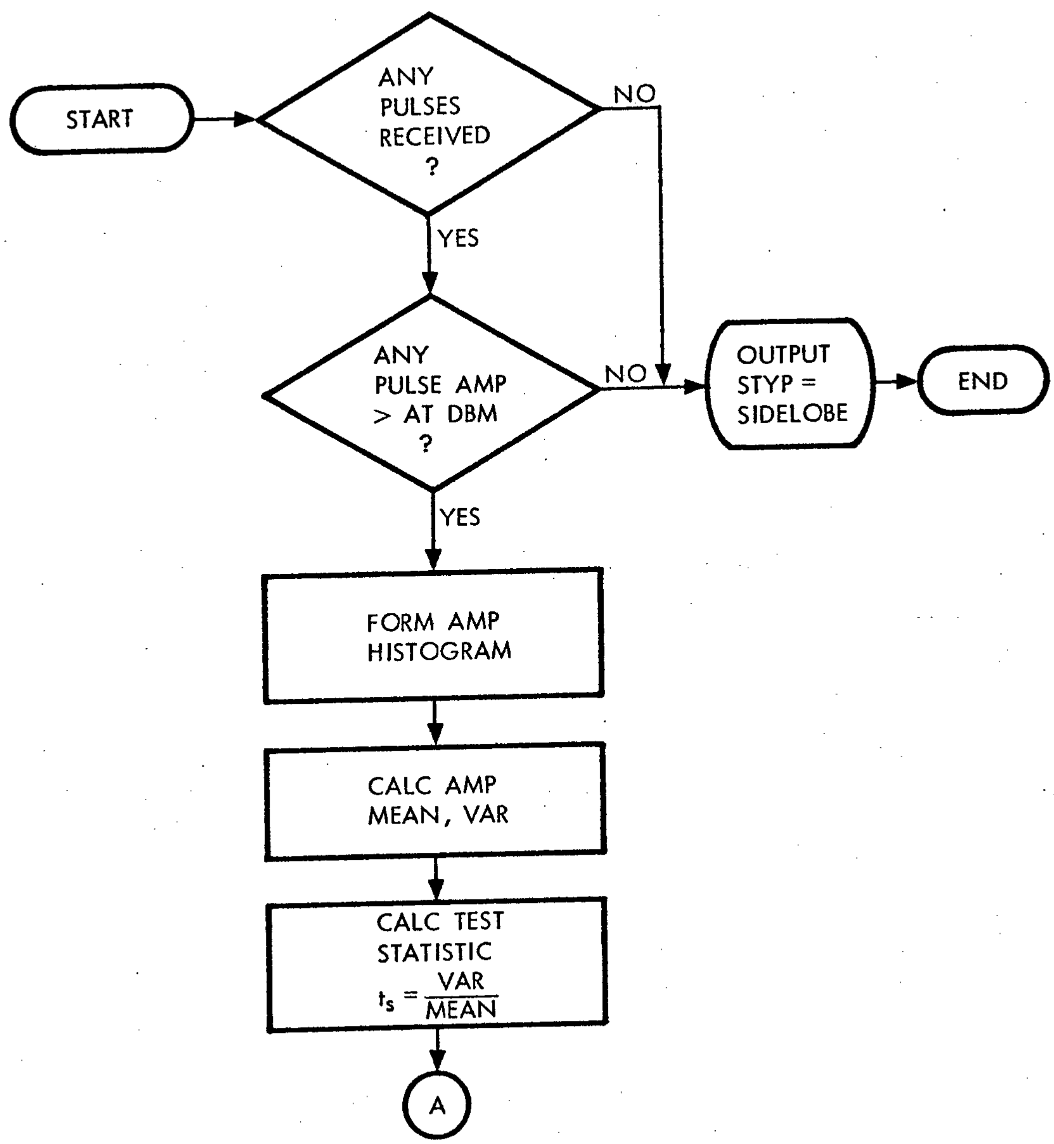


Figure 26. Scan Analysis Logic Flow Diagram (Sheet 1)

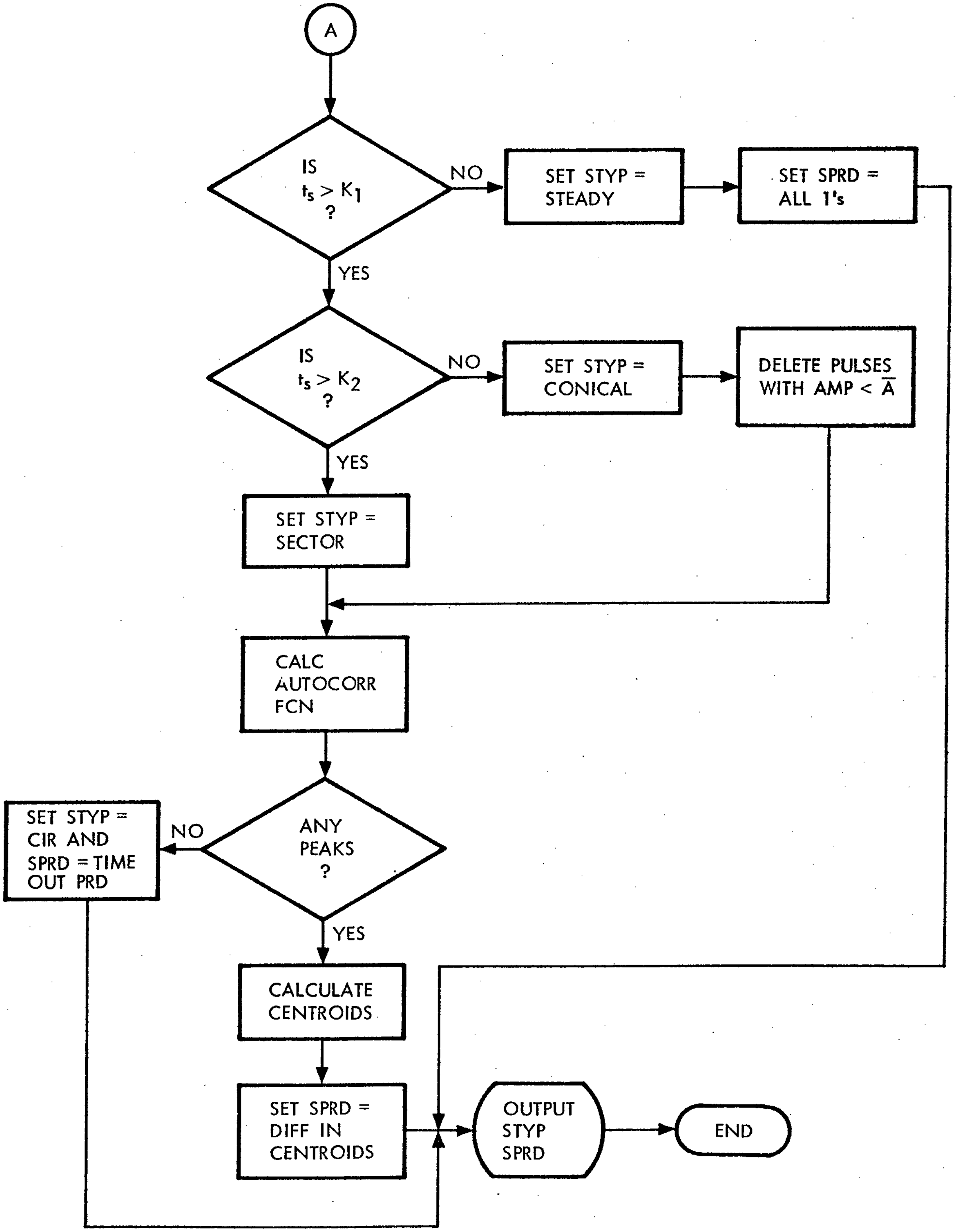


Figure 26. Scan Analysis Logic Flow Diagram (Sheet 2)

shall determine the value of the amplitude field received. If the minimum value of the amplitude field indicates that the received amplitude is less than A_T dBm (A_T is programmable), then the SA module shall set the scan type to sidelobe, shall notify the level 2 search module, and shall exit. If the received amplitude is greater than A_T dBm, the SA module shall shift the histogram down in value by the minimum value of the amplitude field so that the first non-zero bin occupied by the histogram is the zero amplitude value. The histogram shall then be limited at the high end to contain only ten bins numbered 0 to 9_{10}.

The SA module shall calculate the mean value, $\overline{A}$, of the amplitude according to the formula:

$$\overline{A} = 1/N \sum_{i=0}^{m-1} i n_i$$

where m = number of histogram bins;

n_i = histogram count for the ith bin, and

$$N = \sum_{i=0}^{m-1} n_i$$

The variance of the histogram shall be calculated according to the formula:

$$\sigma_A{}^2 = \overline{A^2} - \overline{A}^2$$

where

$$\overline{A^2} = 1/N \sum_{i=0}^{m-1} i^2 n_i$$

The SA module shall calculate the test statistic, t_s, as the ratio of the variance to the mean value, that is:

$$t_s = \frac{\sigma_A{}^2}{\overline{A}}$$

The SA module shall test t_s against programmable values K_1 and K_2 to make the scan type decision as follows:

if $0 \le t_s \le K_1$, conclude steady scan.

if $K_1 < t_s \le K_2$, conclude conical scan.

if $K_2 < t_s < \infty$, conclude sector scan.

If the test statistic indicates a steady scan, the scan period shall be set equal to the maximum value. The SA module shall output the scan type and scan period to the requesting software module and shall then exit.

If the test statistic indicates a conical scan, the SA module shall delete all pulses in the TOA array with amplitude values less than $\overline{A}$. The SA module shall then proceed to the calculation of the autocorrelation function.

Using the TOA array, the SA module shall calculate the autocorrelation function of the received pulse train. The resulting autocorrelation function shall be denoted R (τ) where the value of R (τ) is the number of coincident pulses at a time shift of τ microseconds. For example, at $\tau = 0$ the value of R (o) will be the total number of pulses, M, in the TOA array. The SA module shall search the autocorrelation function for peaks in R (τ) for $\tau > 0$. If any peaks are found, the adjacent τ values shall be subtracted to form

$$\Delta \tau_i = \tau_i - \tau_{i \pm 1}$$

Successive values of $\Delta \tau_i$ shall be calculated by moving away from the peaks until a $\Delta \tau_j$ is found such that

$$\Delta \tau_j \geq 2\,AVPRI$$

The last value of R (τ) for which $\Delta \tau_i < 2\,AVPRI$ shall be defined as the edge of a lobe. Both edges of the lobe shall be determined. A maximum of three lobes away from the lobe at $\tau = 0$ shall be determined. The centroid of the k th lobe shall be determined by the formula:

$$T_k = \frac{\sum\limits_{i \in I_k} \tau_i R(\tau_i)}{\sum\limits_{i \in I_k} R(\tau_i)}$$

where I_k is the set of i such that τ_i is included in the k th lobe.

The scan period, P_S, shall be determined as the average of the difference of the centroids of successive lobes. That is,

$$P_S = 1/K \sum_{k=0}^{K-1} (T_{k+1} - T_k)$$

where $K \leq 3$ and $T_0 = 0$.

If no peaks are found, the SA module shall set the scan type to circular and shall assume the value of the time-out period for scan analysis as the scan period. This value will represent a lower bound on the true scan period.

The SA module shall output the scan type and the scan period to the requesting software module, and shall then exit.

3.3.5.2.3 Scan Analysis Outputs

The outputs from the scan analysis module shall be as given in table 34.

3.3.5.3 Frequency Analysis

There shall be no requirement for a frequency analysis module in the ADM version of IEWS. The capability shall exist to add the frequency analysis module as a growth item for the EDM.

Table 34. Scan Analysis Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	SCAN MEASUREMENT STYP SPRD EFN	Level 2 search or Data Acquisition (Update)	Prog Sequence		2 words		
2	BUFFER DONE	ABI Management	Prog Sequence		1 word		

3.3.5.4 PRI Analysis

The PRI analysis (PA) module shall analyze received PDWs for specific emitters to determine certain PRI characteristics of the pulse train. The PA module shall determine the mean value of the PRI and shall provide an indication of the dispersion of the measured PRI. The PA module shall determine if the emitter has group or stagger PRI characteristics. The PA module shall determine the stagger level of the pulse train and the fundamental value of the pulse repetition frequency (PRF) termed the composite PRI.

3.3.5.4.1 PRI Analysis Inputs

The inputs to the PRI analysis module are given in table 35.

3.3.5.4.2 PRI Analysis Processing

The PA module shall follow the logical sequence shown in figure 27. The PA module shall operate upon a buffer containing the TOAs for each PDW received for a specific PRI analysis associated with a given track file. The PA module shall subtract successive TOAs to obtain a new set of data in the form of a PRI array. The PA module shall test the PRI array to identify the type of PRI. The PA module shall search for PRI values that are less than 20 μs. If two or more PRI values are less than 20 μs, and if the pulse doppler flag has not been set, the PA module shall conclude that a group PRI is present. The pulses following those having PRI values less than 20 microseconds shall be deleted from the array and an average PRI for the resultant array shall be computed. The average PRI for the array shall be computed according to the following formula:

$$AVPRI = 1/N \sum_{I=1}^{N} PRI(I)$$

where N is the number of pulses in the PRI array and the PRI (I) are elements of the array. The variance for the array shall be computed according to the following equation:

$$\sigma^2 = 1/(N-1) \sum_{I=1}^{N} \left[PRI(I) - AVPRI \right]^2$$

Also the maximum value of PRI and the minimum value of PRI for the array shall be determined. The dispersion of PRI values shall be computed from the formula:

$$PRID = Max\ PRI - Min\ PRI$$

If the variance is less than a programmable threshold value K_S, then the PRI type shall be designated as stable with stagger level, S, equal to one. If the variance is greater than K_S, further analysis shall be required. The PA module shall calculate the autocorrelation function of the pulse train as follows: The pulse train shall be shifted relative to itself until a pulse in the shifted version of the train lines up with a pulse in the fixed train. The tolerance for the line-up shall be 4 μs. The value of the autocorrelation for any given shift shall be the number of pulses lining up within tolerance. The autocorrelation function shall be evaluated for time shifts less than or equal to one-third of the time interval of the pulse train or until 50 shifts have been made whichever occurs first. The PA module shall then search for peaks in the autocorrelation function which exceed a value of 0.6N. The number of these peaks N_p shall be used to calculate the composite PRI, PRIC, as follows:

$$PRIC = 1/(N_p - 1) \sum_{I=1}^{N_p - 1} \text{Time diff between successive peaks}$$

Table 35. PRI Analysis Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	UNLOAD BUFFER efn buffer number	ABI Manage	Prog Sequence		1 word		
2	START PROCESS efn pdflag	ABI Management	Prog Sequence		1 word		
3	time-of-arrival	ABI Buffer	Data File Access		1 word		

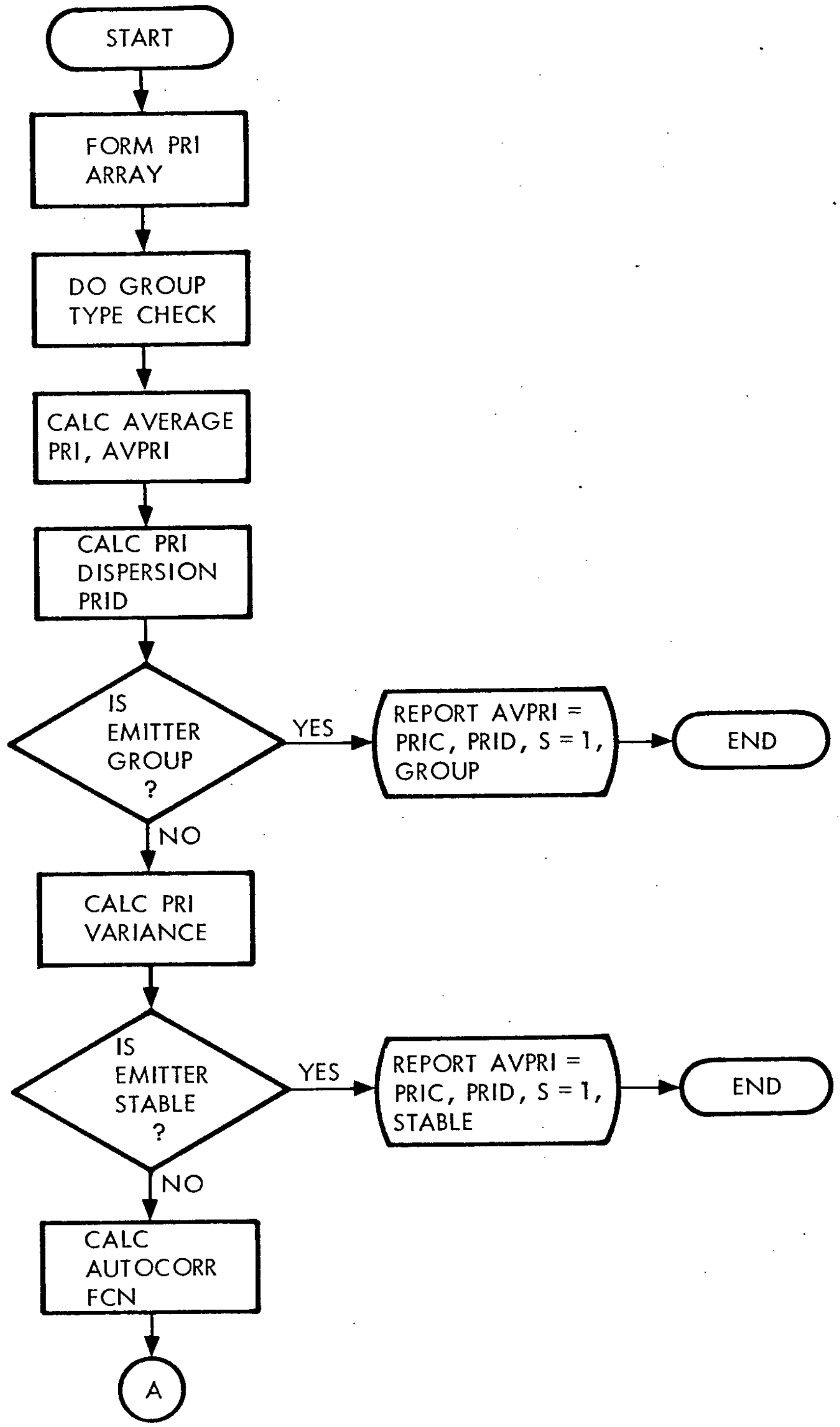


Figure 27. PRI Analysis Logic Flow Diagram (Sheet 1)

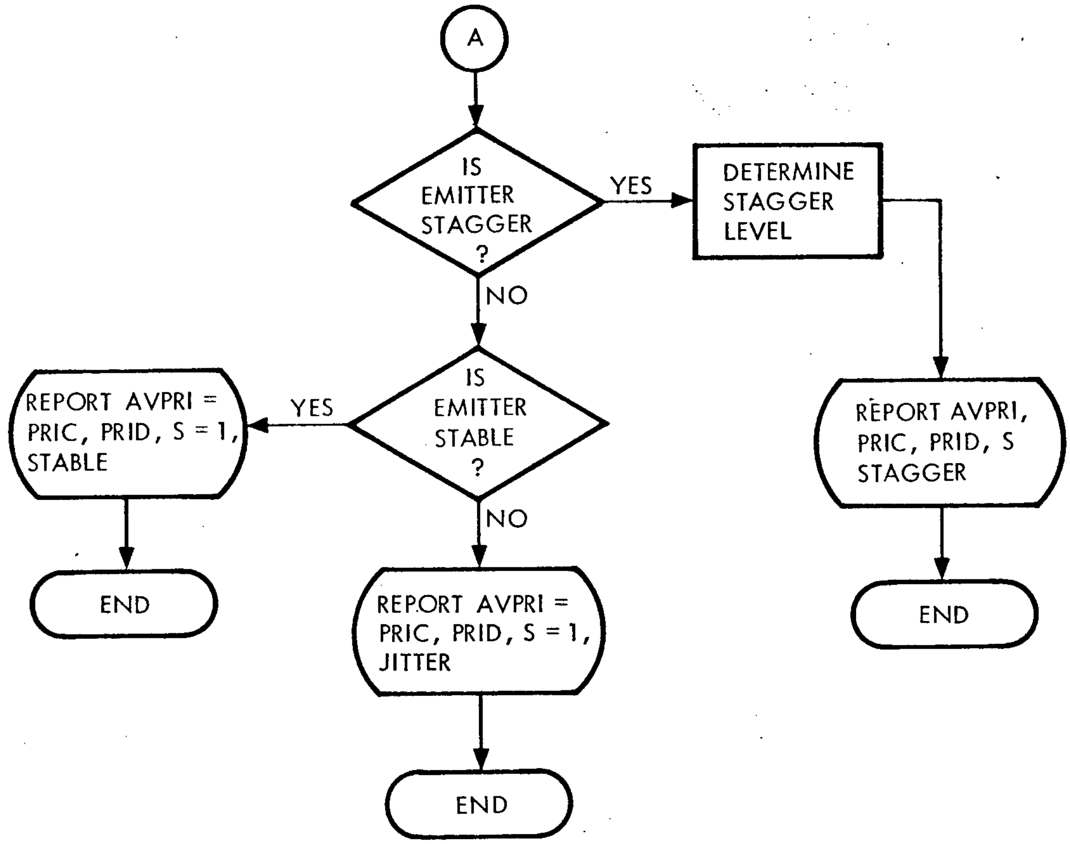


Figure 27. PRI Analysis Logic Flow Diagram (Sheet 2)

The composite PRI, if it exists, will be the PRI for the sum of the staggered PRIs in a staggered PRI train. Hence, if this value, PRIC, is significantly greater (≥ 1.5 AVPRI) than the average PRI, the PA module shall assume a staggered emitter. If the composite PRI is less than 1.5 AVPRI, then the PA module shall designate the PRI type as stable with $S = 1$.

If PRIC ≥ 1.5 AVPRI, the PA module shall determine the number, P, of secondary peaks greater than $0.14N$ located between the origin of the autocorrelation function and the first primary peak. If $10 < P \leq 16$, the PA module shall request an input buffer containing $1.5N$ pulses and shall exit. If $P > 16$, the PA module shall request $3N$ pulses and shall exit. If $P \leq 10$, the PA module shall continue.

If P is even, the stagger level, S, shall be set equal to P/2. If P is odd, the PA module shall check to see if there are any secondary peaks 1.8 times greater than the other secondary peaks. If extra large secondary peaks exist, P shall be incremented by one. If there are no extra large secondary peaks, secondary peaks between $0.12N$ and $0.14N$ shall be determined. If additional secondary peaks are found, the value of P shall be incremented by the number of additional secondary peaks and shall be tested for an even value by repeating this paragraph. If no additional secondary peaks are found, the value of P shall be decremented by one and S shall be set equal to P/2.

If no primary peaks are found $> 0.6N$, the PA module shall designate the PRI type as jitter and shall set $S = 1$.

If a PRI type is determined, the PA module shall output the following information to the calling module:

1) AVPRI,
2) PRID,
3) S,
4) PRIC, and
5) PRI type.

If the PRI type is other than stagger, then AVPRI = PRIC.

3.3.5.4.3 PRI Analysis Outputs

The outputs from the PRI analysis module shall be as given in table 36.

3.3.5.5 Contemporaneous Analysis

The contemporaneous analysis (CA) module shall determine if two or more pulse trains are contemporaneous with each other. A time period will be chosen by the ABI management module during which the pulse trains being analyzed will be gated onto the auxiliary bus. The CA module shall count the PDWs received for each pulse train and shall indicate the pulse trains that are contemporaries of each other. This information shall be returned to the requesting program module.

3.3.5.5.1 Contemporaneous Analysis Inputs

The inputs to the contemporaneous analysis module are given in table 37.

3.3.5.5.2 Contemporaneous Analysis Processing

The CA module shall accept unload buffer messages from the ABI management module. Each time this occurs for a given EFN, the CA module shall increment the PDW count for that EFN by 16_{10} and shall set the buffer status to empty.

When the CA module receives a start-processing message containing up to four EFNs, the PDW counts for those track file entries shall be compared to a programmable threshold $K_c \geq 0$. If the PDW count for a given EFN is greater than K_c, that file entry shall be considered to have received pulses. If the PDW count is less than or equal to K_c, that file entry shall be considered not to have received pulses.

The CA module shall produce a contemporary vector c given by:

where $\bar{c} = c_1, c_2, \ldots c_m \quad 2 \leq m \leq 4$

$c_i = 0$ if no pulses received
$\phantom{c_i = {}}1$ if pulses received

The CA module shall return the contemporary vector, the EFNs, and the PDW counts to the requesting program module. The CA module shall clear its memory for the processed EFNs and shall then exit.

Table 36. PRI Analysis Outputs

ITEM	TASK / DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	BUFFER DONE efn	ABI Manage	Prog Sequence		1 word		
2	PRI ANALYSIS REPORT avpri pric prid s pri type	Requesting Module	Prog Sequence		3 words		

Table 37. Contemporaneous Analysis Inputs

ITEM	TASK /DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	UNLOAD BUFFER efn buffer number	ABI Management	Prog Sequence		1 word		
2	START PROCESS efn's	ABI Management	Prog Sequence		3 words		

3.3.5.5.3 Contemporaneous Analysis Outputs

The outputs from the contemporaneous analysis module shall be as given in table 38.

3.3.5.6 Deinterleaving

There shall be no requirement for a deinterleaving module in the ADM version of the IEWS. The capability shall exist to add the deinterleaving module as a growth item for the EDM.

3.3.6 DISPLAY AND CONTROLS (D/C)

The SC shall control the IEWS display and shall respond to operator requests. The D/C consists of a polar symbolic display, an alphanumeric display and several indicators and controls. The SC shall maintain the polar display by periodically sending to the D/C a threat descriptor for each of 64 angle cells, in one of several modes chosen by the operator. The SC shall maintain the alphanumeric display by sending the threat parameters for emitters requested by the operator. The SC shall pass to the display, several indications of environment status and shall pass to other SC modules, operator requests for changes in their operation. The D/C will be capable of operating in several modes (some of them simultaneously). These are given in table 39.

3.3.6.1 Operator Commands

This function shall maintain the DC status file. The DC status file shall contain the status of the D/C controls, and of the display status as defined by operator commands.

3.3.6.1.1 Operator Commands Inputs

The inputs to the operator commands function are given in table 40.

3.3.6.1.2 Operator Commands Processing

The status of all D/C controls shall be read once every 100 ms. If the operator changes the state of any control more than once in any 100 ms period, the intermediate state may not be recognized by this function. Changes in the states of certain controls shall initiate processing to change display operation, to change the hook ID, and to specify ETF entries displayed in the list mode. The D/C data from the last update shall be stored in the D/C status register. The relevant state changes and the processing which they initiate are shown in table 41. However, the states of all D/C controls except system test shall be ignored while the display is in the test mode.

3.3.6.1.2.1 Page. Page shall be maintained by this function and shall designate which eight emitters or adjacent priorities are to be displayed in the list mode.

3.3.6.1.2.1.1 Increment Page. Page shall become

$$p' = p + 1 \pmod{p_0}$$

where p is the last value of page and p_0 is the number of nonblank pages. The number of nonblank pages shall be given by

$$p_0 = \left[T/8 \right] + 1$$

where T is the number of entries in the priority file and [ ] denotes "greatest integer in."

Table 38. Contemporaneous Analysis Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	CONTEMPORARY REPORT efn's e vector pdw counts	Data Acquisition or Link Analysis	Prog Output		3 words		

Table 39. Display Modes

Mode	Control Logic	A/N or Polar	Emitter Displayed	Initiation
Expand	$\text{Expand} \cdot \overline{\text{System Test}} = 1$	Polar	All at Bearing given by Cursor	Expand Button
Priority	$\text{Priority} \cdot \overline{\text{System Test}} = 1$	Polar	Highest 8 Priority	Priority Button
Type	Emitter Type and System Test = 0	Polar	All emitters of Emitter Type	KB Command TBD - TBD 08 - 25
List	$\text{List} \cdot \overline{\text{Acquire}} \cdot \overline{\text{Hook}} \cdot \overline{\text{System Test}} = 1$	A/N	Page IDs (Emitters of priority 8n to 8n + 7)	List Button Page Up/Down
Parameter	$\text{List} \cdot \overline{\text{Acquire}} \cdot \overline{\text{Hook}} + \text{System Test} = 0$	A/N	Hook ID (Hooked or Acquired Emitter)	Hook Cursor or Acquire, Pointer
Test	System Test = 1	Both	Test Emitter	System Test Button

Table 40. Operator Commands Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	system test	D/C Commands			1 bit	10/sec	
2	priority/all	D/C Commands	Programmed Input		1 bit	10/sec	
3	expand	D/C Commands			1 bit	10/sec	
4	hook	D/C Commands			1 bit	10/sec	
5	acquire	D/C Commands			1 bit	10/sec	
6	priority enter	D/C Commands			1 bit	10/sec	
7	tech enter	D/C Commands			1 bit	10/sec	
8	kb command	D/C Commands			1 bit	10/sec	
9	list	D/C Commands			1 bit	10/sec	
10	page down	D/C Commands			1 bit	10/sec	
11	page up	D/C Commands			1 bit	10/sec	
12	cursor	D/C Commands			6 bits	10/sec	
13	pointer	D/C Commands			3 bits	10/sec	
14	last kb entry	D/C Commands			8 bits	10/sec	
15	system test	D/C Status File			1 bit	10/sec	
16	priority/all	D/C Status File			1 bit	10/sec	
17	expand	D/C Status File	Data File Access		1 bit	10/sec	
18	hook	D/C Status File			1 bit	10/sec	
19	acquire	D/C Status File			1 bit	10/sec	
20	priority enter	D/C Status File			1 bit	10/sec	
21	tech enter	D/C Status File			1 bit	10/sec	
22	kb command	D/C Status File			1 bit	10/sec	
23	list	D/C Status File			1 bit	10/sec	

Table 40. Operator Commands Inputs (concl)

ITEM	TASK/DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
24	page down	D/C Status File			1 bit	10/sec	
25	page up	D/C Status File			1 bit	10/sec	
26	page	D/C Status File			7 bits	as necessary	
27	etf no.	Polar Image File	Data File Access		7 bits	as necessary	
28	etf no.	A/N Image File	Data File Access		7 bits	as necessary	
29	pink	ETF	Data File Access		7 bits	as necessary	
30	option no.	JSF	Data File Access		2 bits	.1/sec or as required	
31	hook tf	D/C Status File			7 bits	.1/sec or as required	
32	hook	D/C Status File	Data File Access		1 bit	.1/sec or as required	
33	list	D/C Status File			1 bit	.1/sec or as required	
34	acquire	D/C Status File			1 bit	.1/sec or as required	
35	ma/ml response - a/n	D/C Status File			1 bit	.1/sec or as required	
36	system test	D/C Status File			1 bit	.1/sec or as required	
37	etf no.	A/N Image File	Data File Access		7 bits	as required	
38	function	EL	Data File Access			.1/sec or as required	
39	mode	EL				.1/sec or as required	
40	etf no.	PIF	Data File Access		7 bits	.1/sec or as required	

Table 41. State Changes

CHANGE		RESULT
Page Up	0 → 1	Increment Page
Page Down	0 → 1	Decrement Page
List	0 → 1	Zero Page
KB Command	0 → 1	Process KB
Hook	0 → 1	Process Hook
Acquire	0 → 1	Process Acquire
Expand	0 → 1	Process Expand
Expand	1 → 0	Return Polar
Tech Enter	0 → 1	Modify Technique
Priority Enter	0 → 1	Modify Priority
List Pointer		Modify Pointer
System Test	0 → 1	Begin Test
System Test	1 → 0	End Test
List	0 → 1, 1 → 0	Update Display
Page Up	0 → 1	Update Display
Page Down	0 → 1	Update Display
Priority/All	0 → 1, 1 → 0	Update Display
Expand	0 → 1, 1 → 0	Update Display
Acquire	0 → 1	Update Display
Hook	0 → 1	Update Display
KB Command	0 → 1	Update Display

3.3.6.1.2.1.2 Decrement Page. Page shall become

$$p' = p - 1 \pmod{p_o}$$

where p is the last value of page and p_o is the number of nonblank pages.

3.3.6.1.2.1.3 Zero Page. Page shall be set equal to 0.

3.3.6.1.2.2 Process Keyboard (KB). The last KB entry shall be examined. If it lies between 8 and 25, then polar type shall be changed according to table 42. Polar type shall be used to determine the polar display mode. If the ETF entry, designated by hook ID, is not of the new emitter type, there shall be no valid hook ID. If the last KB entry lies between 01 and 06, then system response to MA/ML emitters shall be changed according to table 42, and a modification message shall be sent to the indicators function. If last KB entry is 00 a master clear message shall be sent to the system management function. (Refer to 3.3.7.) If last KB entry is 99, an auto return message shall be sent to the priority function and technique source shall be set equal to SC in every ETF entry.

3.3.6.1.2.3 Hook and Acquire. This function shall respond to hook and acquire in order to determine an ETF entry selected by the operator for special action.

3.3.6.1.2.3.1 Process Hook. If expand = 0, then the ETF number at the polar image file address given by cursor shall become the new hook ID. If expand = 1, then the ETF number displayed at cursor shall become the hook ID.

3.3.6.1.2.3.2 Process Acquire. If list = 1, then the ETF number whose position in the displayed list is given by list pointer (list image file) shall become the hook ID and the hook TF. If list = 0 (parameter mode) then another of the track files associated with hook ID by PLNK shall become hook TF. All of the track files associated with hook ID shall become hook TF cyclically as acquire repeatedly changes from 0 to 1 to 0.

3.3.6.1.2.3.3 Modify Pointer. If list = 1, the hook ID shall become the ETF number of the ETF entry whose position in the displayed list (AN image file) is given by list pointer. If list = 1, a modification message shall be sent to the AN function.

3.3.6.1.2.4 Process Expand. Cursor shall be added to heading to give expand azimuth. The ID of the highest lethality platform at that azimuth shall become the hook ID.

3.3.6.1.2.5 Return Polar. The highest lethality platform at expand azimuth shall become the hook ID.

3.3.6.1.2.6 Operator Overrides. This function shall respond to operator overrides in order to modify techniques and priorities.

3.3.6.1.2.6.1 Modify Technique. A technique override message shall be sent to the resource assessment function. A modification message shall be sent to the AN function with hook ID.

The operator-designated technique number shall be written into the ETF as primary technique number and technique source shall be set equal to operator. Secondary and tertiary techniques shall be set to invalid.

3.3.6.1.2.6.2 Modify Priority. A priority override message shall be sent to the priority function with last KB entry and hook ID. A modification message shall be sent to the AN function.

Table 42. Priority/Technique/Keyboard Command List

Switch	Keyboard Data	Action
Technique Enter	00	Stop jamming this emitter.
	01 to 98	Change this emitter technique to technique 01 to 98
	99	Return to automatic technique selection for this emitter.
Keyboard Command	00	Generate master system reset (no program load).
	01	Stop blinking polar display symbols.
	02	Blink polar display symbols per normal operation.
	03	Stop blinking AN matrix characters.
	04	Blink AN matrix characters per normal operation.
	05	Inhibit audio alarm (MA/ML) command.
	06	Allow audio alarm (MA/ML) per normal operation.
	08	Change emitter type to SAM
	09	be displayed SA-1
	10	SA-2
	11	SA-3
	12	SA-4 add all
	13	SA-5 to list
	14	SA-6
	15	SA-7
	16	SA-8
	17	SA-9
	18	SA-0
	19	AAA
	20	AI
	21	naval
	22	nonnaval
	23	engaged
	24	unengaged
	25	unknown
	26	TBD
	98	
	99	Revert back to full automatic operation.
Priority Enter	00	TBD
	01	Change this emitter priority to priority 01 (highest).
	02	Change this emitter priority to priority 02.
	03 to 98	Change this emitter priority to priority 03 to 98.
	99	Return to automatic priority selection for this emitter.

3.3.6.1.2.7 System Test. This function shall respond to operator request to begin and end the system test.

3.3.6.1.2.7.1 Begin Test. A begin test message shall be sent to the system test function (Refer to 3.3.10.1.) when system test changes from 0 to 1.

3.3.6.1.2.7.2 End Test. An end test message shall be sent to the system test function when system test changes from 1 to 0.

3.3.6.1.2.8 Update. An update message shall be sent to the AN display function and to the polar display function when any of the D/C controls change state as specified in table 42. The update message shall cause the AN and polar displays to be completely updated.

3.3.6.1.3 Operator Commands Outputs

The outputs from the operator commands function shall be as given in table 43.

3.3.6.2 Polar Display

The polar display shall be updated once every second or whenever there is a D/C mode change. (Refer to 3.3.6.1.) Parameters shall be displayed for the highest lethality ETF entry at each of 64 bearings. In addition, several parameters shall be displayed which summarize the status of all ETF entries at each bearing.

3.3.6.2.1 Polar Display Inputs

Inputs to the polar display function are given in table 44.

3.3.6.2.2 Polar Display Processing

The polar display shall be capable of operating in any one or any combination of five modes: normal, expand, type, priority, and test. In the normal mode, the highest-lethality threat platform at each bearing shall be displayed. In the type mode, only those platforms of a given type (emitter type) shall be considered. In the expand mode, only those platforms at a given bearing shall be considered. In the priority mode, only those platforms with a priority of 1 to 8 shall be considered. If more than one of these modes is in effect at one time, those platforms considered for display shall be the intersection of the sets of platforms which satisfy each of the mode conditions separately. Those conditions are summarized in table 39 along with the D/C control states that determine the mode or modes of operation. In addition, there shall be a test mode, in which only test emitters are displayed. The mode shall be determined according to table 39 whenever an update message is received. An update message will be sent by the operator commands function whenever any of the D/C controls change state as specified in table 42. The polar MA/ML response bit (D/C status file) shall be examined at every update. The ETF shall be read once per second and at each D/C mode change in order to reassess the state of the environment. Data shall be sent to the D/C once every second and for any D/C mode change for all 64 polar addresses. The polar display shall be addressed by bearing, and if no threat is present at a given bearing, that bearing shall be cleared. The data transferred will be displayed as shown in figure 28. Symbols shall be coded as indicated in table 45. All of the required update data discussed above shall be output to the D/C within 25 ms of the start of the update and shall be derived from the same update data. The ETF will not be changed during an update. Therefore, the polar display will not appear to flicker and all information appearing to the operator at one time will be correlated. In particular, the same heading shall be used for all data in one update.

Blinking shall be inhibited if the polar MA/ML response bit is set (defeat). In addition, this function shall output to the polar image file the ETF number of the ETF entry currently displayed at each bearing.

Table 43. Operator Commands Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	TECH OVERRIDE/ etf no.	Res. Assess. Function			1 word	as necessary	
2	PRIORITY OVERRIDE/ etf no	Priority Function			1 word	as necessary	
3	SYSTEM TEST/ start/stop	Class. Function			1 word	as necessary	
4	MASTER CLR	Exec			1 word	as necessary	
5	AUTO RETURN	Priority Function			1 word	as necessary	
6	UPDATE	A/N, Polar Display Fns			1 word	as necessary	
7	MODIFICATION	A/N Display Function Indicators Function			1 word	as necessary	
8	system test	D/C Status File			1 bit	as necessary	
9	priority/all	D/C Status File			1 bit	as necessary	
10	expand	D/C Status File			1 bit	as necessary	
11	hook	D/C Status File			1 bit	as necessary	
12	acquire	D/C Status File			1 bit	as necessary	
13	priority enter	D/C Status File	Data File Access		1 bit	as necessary	
14	tech. enter	D/C Status File			1 bit	as necessary	
15	kb command	D/C Status File			1 bit	as necessary	

Table 43. Operator Commands Outputs (concl)

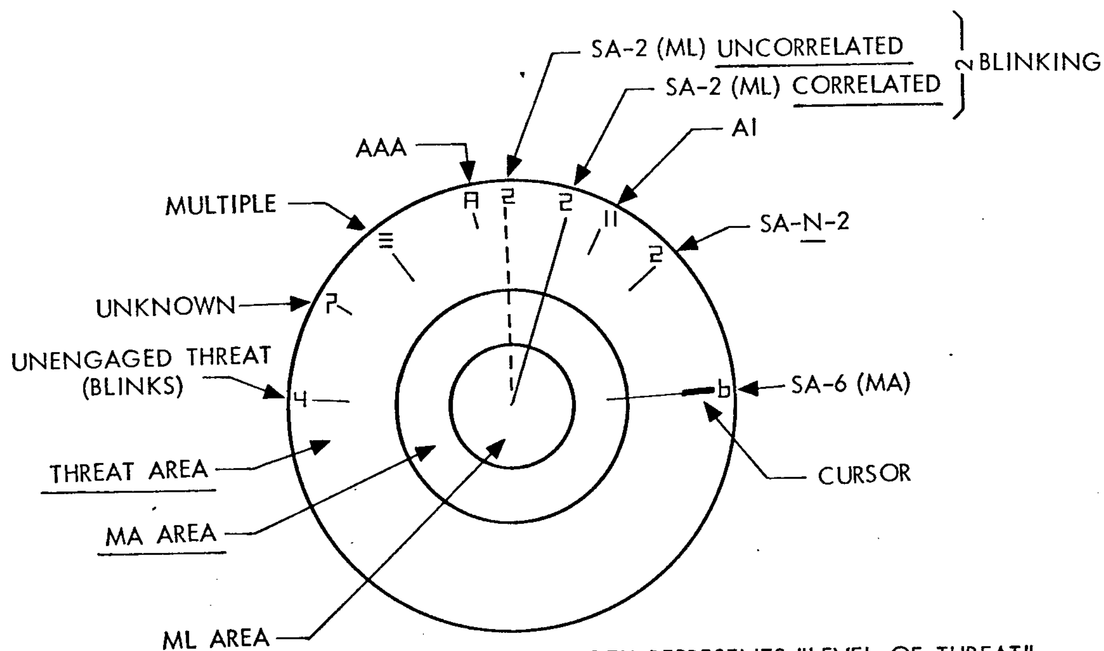
ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
16	list	D/C Status File			1 bit	as necessary	
17	page down	D/C Status File			1 bit	as necessary	
18	page up	D/C Status File			1 bit	as necessary	
19	page	D/C Status File			7 bits	as necessary	
20	hook id	D/C Status File			7 bits	as necessary	
21	hook tf	D/C Status File			7 bits	as necessary	
22	emitter type	D/C Status File			5 bits	as necessary	
23	expand az.	D/C Status File			6 bits	as necessary	
24	ma/ml response	D/C Status File			3 bits	as necessary	
25	tech source	ETF	Data File Access		1 bit	as necessary	
26	primary tech	ETF			7 bits	as necessary	
27	secondary tech	ETF			7 bits	as necessary	
28	tertiary tech	ETF			7 bits	as necessary	

Table 44. Polar Display Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	UPDATE	Operator Com Function			1 word	as required	
2	MODIFICATION/etf no.	Operator Com Function			1 word	as required	
3	RTC INTERRUPT	SC	Interrupt		1 word	1/sec	
5	ma el no.	ETF			8 bits		
6	file active	ETF			1 bit		
7	platform link	ETF	Data File Access		7 bits		
8	cor. link	ETF			7 bits	1/sec or as necessary	
9	aximuth	ETF			8 bits		
10	display code	ETF			5 bits		
11	lethality	ETF			6 bits		
12	max amp	ETF			5 bits		
13	engaged	ETF			1 bit		
14	hook	ETF			1 bit		
15	acquire	ETF			1 bit		
16	list	ETF			1 bit		

Table 44. Polar Display Inputs (concl)

ITEM	TASK / DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
17	ma/ml response-polar	ETF			1 bit	1/sec or as necessary	
18	emitter type	D/C Status File	Data File Access		5 bits	1/sec or as necessary	
19	hook id	D/C Status File			7 bits	1/sec or as necessary	
20	expand	D/C Status File			1 bit	1/sec or as necessary	
21	expand az	D/C Status File			6 bits	1/sec or as necessary	
22	priority/all	D/C Status File			1 bit	1/sec or as necessary	
23	system test	D/C Status File			1 bit	1/sec or as necessary	
24	heading	INSF	Data File Access		6 bits	1/sec or as necessary	
25	mode	EL	Data File Access			1/sec or as necessary	
26	function	EL				1/sec or as necessary	



NOTES: 1. VECTOR LENGTH REPRESENTS "LEVEL-OF-THREAT"
2. CENTER OF CRT IS ML AREA
3. MID-BAND OF CRT IS MA AREA
4. DOTTED VECTOR REPRESENTS AN UNCORRELATED EMITTER EMITTER

Figure 28. Typical Polar Display Presentation

3.3.6.2.2.1 Normal Mode. For each azimuth, this function shall determine the ETF platform chain of highest nonzero lethality at that azimuth. All the parameters of a platform chain (including azimuth, lethality, and ETF number) shall be the corresponding parameters of the highest-lethality ETF entry in that chain. The SC shall also determine if more than one threat platform is present at each azimuth and if any ML threats are at each azimuth. An ML threat is one which is identified as a missile guidance signal and does not have its MA bit set. Any active ETF entry with lethality $\neq 0$ shall be considered a threat. The parameters for each of those emitters shall then be determined as shown in table 46. Polar display update shall be accomplished as shown in figure 29. Bearing shall be determined for each azimuth by subtracting heading from azimuth. Threat level shall be calculated for the highest-lethality platform at each azimuth as follows (L equals lethality, and L1, L2, . . . , L5 are programmable limits):

Threat Level	ML / MA	Lethality
0	ML set	$L > L1$
1	ML set	$L \leq L1$
2	MA set	$L > L2$
3	MA set	$L \leq L2$
4	neither set	$L3 < L$
5	neither set	$L4 < L \leq L3$
6	neither set	$L5 < L \leq L4$
7	neither set	$L \leq L5$

Table 45. Polar Display Symbols

Symbol	Code 11	10	9	8	Comments
Blank	0	0	0	0	No Symbol Displayed
1	0	0	0	1	SA-1
2	0	0	1	0	SA-2
3	0	0	1	1	SA-3
4	0	1	0	0	SA-4
5	0	1	0	1	SA-5
6	0	1	1	0	SA-6
7	0	1	1	1	SA-7
8	1	0	0	0	SA-8
9	1	0	0	1	SA-9
0	1	0	1	0	SA-0
A	1	0	1	1	AAA
II	1	1	0	0	AI
ᄂ	1	1	0	1	Unengaged Threat
?	1	1	1	0	Unknown
≡	1	1	1	1	Multiple

Table 46. Polar Displayed Data

Data	Source	Source File	Conversion
bearing	heading azimuth	INSF ETF	az - hdg
type	display code	ETF	
engaged	engaged	ETF	
naval	display code	ETF	
threat level	lethality function, mode	ETF EF	Refer to 3.3.6.2.2.1
uncorrelated	correlated link function, mode	ETF EF	(No cor entry) · ML
ML * +	function, mode MA	EF ETF	(missile guidance) · $(\overline{MA} + ML)$ (missile guidance) · MA · $\overline{ML}$
Multiple +	platform link	ETF	> entry with ETF no. > PLNK

* May be inhibited (Refer to 3.3.6.1.2.4.)

\+ Displayed for all such emitters

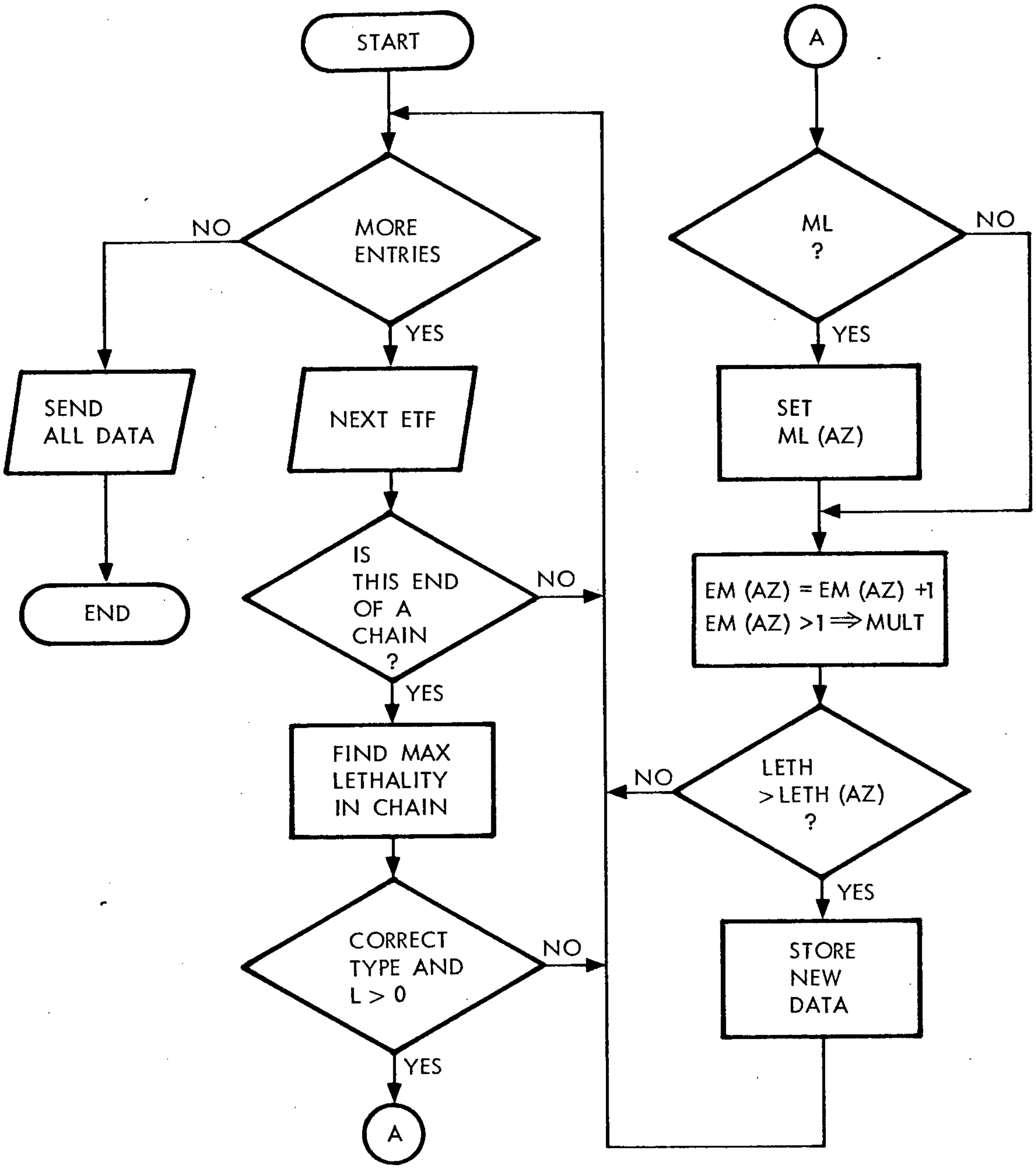


Figure 29. Polar Display Update

All parameters shall be encoded for the highest-lethality platform at each azimuth. In addition, the following quantities shall be calculated:

hook bearing = azimuth (hook ID) - heading

where azimuth (hook ID) denotes the azimuth of the ETF entry given by hook ID. Similarly,

cursor bearing = azimuth (cursor ID) - heading

where cursor ID is the ETF number of the platform currently displayed at cursor (from the polar image file). If multiple platforms are at that azimuth, then cursor bearing shall remain unchanged.

Both bearing and cursor shall be determined at the time the respective bearings are updated. The new values of cursor bearing and hook bearing shall be sent to the D/C within 10 ms of the time the old quantities were read from the D/C.

Hook bearing and cursor bearing shall be used to update the D/C polar display hook and cursor symbols so that they normally follow the ETF entry which they designate until operator intervention. The calculation of hook bearing shall only be made in the parameter mode. (Refer to 3.3.6.3.2.)

3.3.6.2.2.2 Type Mode. When operating in the type mode, the polar display update shall be carried out exactly as it is in the normal mode (Refer to 3.3.6.2.2.1.), except that only ETF entries whose type, engaged, naval, and EFN correspond to emitter type (D/C status file) shall be considered. All other ETF entries shall be ignored.

3.3.6.2.2.3 Priority Mode. When operating in the priority mode, polar display update shall be carried out exactly as in the normal mode (Refer to 3.3.6.2.2.1.), except that only ETF entries whose priorities are between 1 and 8 (inclusive) shall be considered. The ETF numbers of the ETF entries of those priorities shall be read from the priority file. All other ETF entries shall be ignored.

3.3.6.2.2.4 Expand Mode. When operating in the expand mode, this function shall determine all platform chains at the azimuth given by expand azimuth (D/C status file). All the parameters of a platform chain shall be the corresponding parameters of the highest-lethality ETF entry in that chain. Threat level shall be calculated, as it was for normal mode operation (Refer to 3.3.6.2.2.1.), for all platforms at expand azimuth. All parameters shall be encoded for all platforms at expand azimuth. Bearings shall be artificially assigned to these platforms in the following manner:

highest lethality:	azimuth - heading
2nd highest lethality:	azimuth - heading + 1
3rd highest lethality:	azimuth - heading - 1
4th highest lethality:	azimuth - heading + 2
nth highest lethality:	azimuth - heading + $(-1)^n \left[n/2 \right]$

Therefore all of the platforms at the designated bearing will be spread out into adjacent bearings with the higher-lethality, and therefore higher-priority, platforms closer to the designated bearing. In addition, the following quantities shall be calculated:

hook bearing = bearing (hook ID)

where bearing (hook ID) is the assigned bearing (above) of the ETF entry given by hook ID. Similarly,

cursor bearing = bearing (cursor ID)

where bearing (cursor ID) is the assigned bearing of the ETF entry which is currently displayed at cursor. Hook bearing and cursor shall be determined at the time the respective bearings are updated. The new values of cursor bearing and hook bearing shall be sent to the D/C within 10 ms of the time the old quantities were read from the D/C.

3.3.6.2.2.5 Test Mode. When operating in the test mode, polar display update shall be carried out exactly as in the type mode (Refer to 3.3.6.2.2.2.) with type = test.

3.3.6.2.3 Polar Display Outputs

The outputs from the polar display function shall be as given in table 47.

3.3.6.3 AN Display

The AN display shall be updated once every 10 seconds or whenever there is a D/C mode change (Refer to 3.3.6.1.2.). In the parameter mode, parameters shall be displayed for the ETF number designated by hook TF. In the list mode, parameters shall be displayed for up to eight emitters designated by page.

3.3.6.3.1 AN Display Inputs

The inputs to the AN display function are given in table 48.

3.3.6.3.2 AN Display Processing

The AN display shall be capable of operating in either of three mutually exclusive modes: parameter mode, list mode, or test mode. In the parameter and test modes, the AN display shall present various parameters for one designated ETF entry. In the list mode, the AN display shall present various parameters (fewer than in the parameter mode) for eight ETF entries at a time. The ETF entries displayed shall be eight entries of consecutive priority and shall be determined by page. Data displayed and the source of the data is given in table 49.

3.3.6.3.2.1 Parameter Mode. Parameters of the ETF entry designated by hook ID (Refer to 3.3.6.1.2.) shall be displayed. Display data shall be updated whenever one of three events occurs: the passage of a ten-second interval, an update message, or a modification message. An update or modification message will be received when any of the D/C controls changes state as specified in table 47. The parameters of the designated emitter shall be read, converted to decimal (where necessary), and coded in ASCII as indicated in table 50. Whenever a modification message is received from the operator commands function, the AN display shall be updated immediately. Data shall then be sent for each position. The A/N display shall be addressed by row and column, and if no information is to be displayed at a given location, that location shall be cleared. The information shall be formatted as shown in figure 30. All of the required A/N update data shall be sent to the D/C within 10 ms and shall be derived from the same set of update data. Therefore, the A/N display will not appear to flicker and all information appearing to the operator at one time will be correlated.

3.3.6.3.2.2 Test Mode. When operating in the test mode, AN display update shall be carried out exactly as in the parameter mode (Refer to 3.3.6.3.2.1.) except that the designated ETF entry shall not be determined by hook TF. Instead, the designated ETF entry shall be any entry which is being displayed on the polar display and whose bearing lies between 16 and 47 (inclusive).

Table 47. Polar Display Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	uncorrelated	D/C			1 bit	1/sec or as necessary	
2	threat level	D/C			3 bit	1/sec or as necessary	
3	symbol	D/C			4 bit	1/sec or as necessary	
4	naval	D/C	Programmed Output		1 bit	1/sec or as necessary	
5	blink	D/C			1 bit	1/sec or as necessary	
6	sector address	D/C			6 bit	1/sec or as necessary	
7	hook position	D/C			6 bit	1/sec or as necessary	
8	cursor position	D/C			6 bit	1/sec or as necessary	
9	etf no.	Polar Image File	Data File Access		7 bit		

Table 48. AN Display Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	UPDATE/etf no.	Operator Com Function			1 word	as required	
2	MODIFICATION	Operator Com Function			1 word	as required	
3	RTC INTERRUPT	SC	Interrupt		1 word	10/sec	
4	ma	ETF			1 bit	.1/sec or as required	
5	el no.	ETF			8 bits	.1/sec or as required	
6	azimuth	ETF			8 bits	.1/sec or as required	
7	display code	ETF			5 bits	.1/sec or as required	
8	frequency	ETF	Data File Access		16 bits	.1/sec or as required	
9	max amp	ETF			5 bits	.1/sec or as required	
10	avg. pri	ETF			14 bits	.1/sec or as required	
11	pw	ETF			4 bits	.1/sec or as required	
12	tech 1	ETF			7 bits	.1/sec or as required	
13	tech 2	ETF			7 bits	.1/sec or as required	
14	tech 3	ETF			7 bits	.1/sec or as required	
15	tech source	ETF			1 bit	.1/sec or as required	
16	engaged	ETF			1 bit	.1/sec or as required	

Table 48. AN Display Inputs (concl)

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
17	etf no.	PF	Data File Access		7 bits	.1/sec or as required	
18	chan no.	PF			5 bits	.1/sec or as required	
19	priority source	PF			1 bit	.1/sec or as required	
20	heading	INSF	Data File Access		6 bits	.1/sec or as required	

Table 49. AN Displayed Data

Data	Source	Source File	Conversion (Source to Data)
ML, MA *	function, mode MA	EF ETF	ML = missile guidance $\cdot$ ($\overline{MA}$ + ML) MA = missile guidance $\cdot$ $\overline{MA}$ $\cdot$ $\overline{ML}$
number of ETFs +	platform link	ETF	number of entries with ETF no. < PLNK
frequency	freq	ETF	
azimuth	azimuth	ETF	
ampl +	max ampl	ETF	
PRI +	avg PRI	ETF	
PW +	PW	ETF	
type	display code	ETF	
tech	tech	JSF	
tech source	tech source	ETF	
priority	priority	PF	
priority source	priority source	PF	
unengaged	unengaged	ETF	

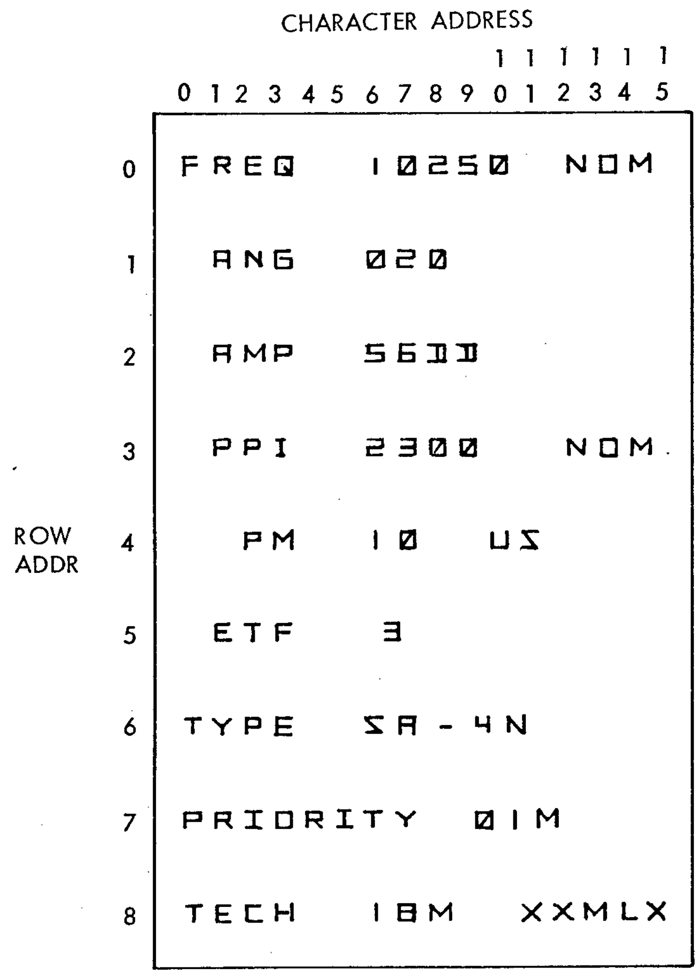
* May be inhibited (Refer to 3.3.6.1.2.4.)

\+ Displayed only in parameter mode

Table 50. AN Character Code (ASCII)

Octal	Character	Symbol *	Octal	Character	Symbol *
00	@	@	40	blank	
01	A	A	41	!	.'
02	B	B	42	"	''
03	C	C	43	#	#
04	D	D	44	$	$
05	E	E	45	%	%
06	F	F	46	&	&
07	G	G	47	'	'
10	H	H	50	(	<
11	I	I	51	)	>
12	J	J	52	*	*
13	K	K	53	+	+
14	L	L	54	,	'
15	M	M	55	minus	–
16	N	N	56	.	.
17	O	O	57	/	/
20	P	P	60	0	0
21	Q	Q	61	1	1
22	R	R	62	2	2
23	S	S	63	3	3
24	T	T	64	4	4
25	U	U	65	5	5
26	V	V	66	6	6
27	W	W	67	7	7
30	X	X	70	8	8
31	Y	Y	71	9	9
32	Z	Z	72	:	:'
33	[	[	73	;	;'
34		\	74	<	<
35	]	]	75	=	=
36		^	76	>	>
37	–	–	77	?	?

* 17 segment starburst LED matrix only.



NOTES:

1. ETF (EMITTER TRACK FILE) NUMBER REFERS TO THE TOTAL NUMBER OF FILES RELATING TO ONE EMITTER. EACH INDIVIDUAL FILE IS DISPLAYED BY ACTIVATING THE ACQUIRE SWITCH ONCE PER FILE. THE ETF NUMBER REMAINS THE SAME FOR EACH FILE.
2. M CHARACTER APPENDED TO EITHER PRIORITY OR TECHNIQUE NUMBER SIGNIFIES MANUAL ASSIGNMENT.
3. N CHARACTER APPENDED TO "TYPE" SIGNIFIES A NAVAL EMITTER.
4. AOA IS RELATIVE BEARING TO EMITTER.
5. FIVE CHARACTER FIELD AT LOWER RIGHT (ROW 8, CHAR ADDR 11/15) SHOWS "ML," "MA" OR "MNENG" EMITTERS, ML CHARACTERS BLINK.

Figure 30. Typical Alphanumeric Matrix Parameter Format

3.3.6.3.2.3 List Mode. The parameters of the emitters designated by page IDs below shall be displayed. Page IDs shall be determined periodically and parameters displayed shall be updated as necessary.

3.3.6.3.2.3.1 Page IDs. Once every 10 s and whenever an update message is received from the operator commands function, new page IDs shall be determined. Page IDs shall be the IDs of those emitters which have priorities given by 8 x page, 8 x page + 1, . . . , 8 x page + 7. (Refer to 3.3.4.1.)

3.3.6.3.2.3.2 Parameter Updates. Whenever new page IDs are determined, and whenever a modification message is received, the parameters of the designated ETF entries shall be read, converted to decimal (where necessary), and coded in ASCII as indicated in table 50. A modification message, however, shall cause no change in the image file or in the ETF entries which are displayed. The AN display shall be addressed by row and column, and if no information is to be displayed at a given location, that location shall be cleared. The information shall be formatted as shown in figure 31. The emitters shall be listed in order of their priority, at the time of selection (Refer to 3.3.6.2.2.1.) with the emitters of higher priority closer to the top of the display. All of the required AN update data shall be output to the D/C within 25 ms of the start of the update, and shall be derived from the same set of update data. Therefore, the AN display will not appear to flicker and all information appearing to the operator at one time will be correlated.

The AN image file shall be accessed by list position (row) and shall contain the ETF number whose parameters are displayed at that list position. The AN image file shall be maintained by this function.

3.3.6.3.3 AN Display Outputs

The outputs from the AN display function shall be as given in table 51.

3.3.6.4 Indicators

D/C indicators shall be updated once every second, and whenever a modification message is received. The indicators will include audio alarms for MA/ML conditions, a symbol in the center of the polar display indicating an uncorrelated MA/ML, and a lamp which indicates the presence of an unengaged threat.

3.3.6.4.1 Indicators Inputs

The inputs to the indicators function are given in table 52.

3.3.6.4.2 Indicators Processing

Display indicator data shall be updated once a second by performing the following sequence. The MA/ML response field of the D/C status file shall be read to determine which indicators if any have been defeated (always off). The threat ETF entries shall then be searched for any of the conditions which would cause those non-defeated indicators to be active. Any active ETF entry with lethality $\neq 0$ shall be considered a threat. The indicators, with the condition that shall cause them to be active, and with the MA/ML response bit that shall cause them to be defeated are as follows:

Indicator	Condition	MA / ML Response Bit
audio	any MA	audio
audio	any ML	audio
lamp	any unengaged threat	

CHARACTER ADDRESS

1 1 1 1 1 1

0 1 2 3 4 5 9 7 8 9 0 1 2 3 4 5

ROW ADDR				
0	P	TYP	ANG	TECH
1	01M	4N	020	18M
2	02	3	330	23
3	03	2	015	18
4	04M	b	000	31
5	05	AI	061	20
6	>06	AA	071	02M<
7	07	77	330	23
8	08	3	330	23

NOTES:

1. M CHARACTER APPENDED TO EITHER PRIORITY OR TECHNIQUE SIGNIFIES MANUAL ASSIGNMENT.
2. N CHARACTER APPENDED TO "TYPE" SIGNIFIES A NAVAL EMITTER.
3. ANGLES SHOWN ARE RELATIVE BEARINGS TO EMITTERS.
4. THE ENTIRE ROW OF CHARACTERS BLINKS FOR ML EMITTERS.

Figure 31. Typical Alphanumeric Matrix List Format

Table 51. AN Display Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	row addr.	D/C			4 bits	.1 sec or as necessary	
2	char addr.	D/C	Programmed Output		4 bits	.1 sec or as necessary	
3	blink	D/C			1 bit	.1 sec or as necessary	
4	char.	D/C			6 bits	.1 sec or as necessary	
5	clear a/n	D/C			1 bit	.1 sec or as necessary	

Table 52. Indicators Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	UPDATE	Operator Com			1 word	as necessary	
2	LOAD END	Function					
3	MODIFICATION	Operator Com			1 word	as necessary	
4	RTC INTERRUPT	SC	Interrupt		1 word	1/sec	
5	function	EL	Data File Access			1/sec or as required	
6	mode	EL				1/sec or as required	
7	ma	ETF	Data File Access		1 bit	1/sec or as required	
8	el no.	ETF			7 bits	1/sec or as required	
9	cor. link	ETF			7 bits	1/sec or as required	
10	engaged	ETF			1 bit	1/sec or as required	
11	bearing	ETF			6 bits	1/sec or as required	
12	ma/ml response-indic.	D/C Status File	Data File Access		1 bit	1/sec or as required	

Updated indicator data shall be sent after each update to the D/C. Any indicator which has been defeated shall be made inactive. In addition, clear PL shall be sent whenever a load end message is received from the executive function. This message will cause the D/C program load lamp to be extinguished. The SC shall have no responsibility for lighting that lamp. Data displayed and their sources are shown in table 53.

Table 53. Displayed Data for Indicators

Data	Source	Source File	Conversion
uneng.	uneng.	ETF	–
MA, ML	function, mode MA	EF ETF	ML = missile guidance · $\overline{MA}$
uncor.	cor. link	ETF	(no cor. entry) · ML

3.3.6.4.3 Indicators Outputs

The outputs from the indicators function shall be as given in table 54.

3.3.7 SYSTEM MANAGEMENT

System management shall consist of a number of programs which provide certain control functions and which distribute miscellaneous data items to various users within the system. This computer program shall contain three such programs: signal threshold control, emitter track file overflow control, and aircraft altitude and altitude data distribution.

3.3.7.1 Signal Threshold Control

The input PDW data rate shall be controlling by this program to prevent the SS from being overloaded due to sustained high pulse rate conditions.

3.3.7.1.1 Signal Threshold Control Inputs

The inputs to the signal threshold control function are given in table 55.

3.3.7.1.2 Signal Threshold Control Processing

This program shall respond to input buffer alert messages generated by the SS and shall adjust the encoding threshold located in the parameter encoder. This algorithm shall be of a bang-bang servo type implemented as follows.

An input buffer alert indicating greater than 3/4 full shall cause the encoding threshold to be incremented by one position.

An input buffer alert indicating less than 1/4 full shall cause the encoding threshold to be decremented by one position.

Provisions shall be included in the program to prevent the encoding threshold from exceeding either the upper or lower limit on the threshold range.

3.3.7.1.3 Signal Threshold Control Outputs

The outputs from the signal threshold control function shall be as given in table 56.

Table 54. Indicators Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	uneng. threat	D/C			1	1/sec or as necessary	
2	ml and	D/C			1	1/sec or as necessary	
3	ma and	D/C	Programmed Output		1	1/sec or as necessary	
4	ma bu	D/C			1	1/sec or as necessary	
5	ml bu	D/C			1	1/sec or as necessary	
6	clear PL	D/C			1	1/sec or as necessary	

Table 55. Signal Threshold Control Inputs

ITEM	TASK /DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	1B 1/4 Full	Sorter	I/O Message		1 word	input dependent	
2	1 B 3/4 Full	Sorter	I/O Message		1 word	input dependent	

Table 56. Signal Threshold Control Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
	Modify Threshold	Parameter Encoder	I/O Message		1 word	as required	

3.3.7.2 Emitter Track File Overflow

The emitter track file overflow function shall allow the system to adapt to situations when the number of emitters exceeds the file capacity of the SS.

3.3.7.2.1 Emitter Track File Overflow Inputs

The inputs to the emitter track file overflow function are given in table 57.

3.3.7.2.2 Emitter Track File Overflow Processing

This program shall be executed in response to sorter track file full alert messages generated by the SS unit. This condition will exist whenever all track file locations have been filled and another emitter has been detected within the NESU. The SC shall respond to such conditions using the following sequence.

1) The ETF shall be searched starting at the highest numbered location for an emitter which has zero priority.
2) The parameters of the overflow emitter shall be inserted in both the STF and ETF.
3) The overflow emitter shall be processed as a new emitter.

3.3.7.2.3 Emitter Track File Overflow Outputs

The outputs from the emitter track file overflow function shall be as given in table 58.

3.3.7.3 Aircraft Altitude and Altitude Data Distribution

The SC shall obtain aircraft altitude and altitude information for use in internal programs and shall distribute the azimuth correction factor to the parameter encoder.

3.3.7.3.1 Aircraft Altitude Inputs

The input to the aircraft altitude and altitude data distribution function are given in table 59.

3.3.7.3.2 Aircraft Altitude Processing

This program shall periodically interrogate the aircraft inertial navigation system to obtain data on:

1) altitude,
2) pitch,
3) roll, and
4) aircraft heading.

These parameters shall be obtained every 100 ms and shall be stored in a common memory location to be used as required by other programs.

Table 57. Emitter Track File Overflow Inputs

ITEM	TASK /DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	File Full	Signal Sorter	I/O Message				

Table 58. Emitter Track File Overflow Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Delete File	Signal Sorter	I/O Message				

Table 59. Aircraft Altitude Inputs

ITEM	TASK DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	INS readout altitude heading	Inertial Navigation System	I/O Message			100 msec	

3.3.7.3.2.1 Azimuth Correction Factor. An azimuth correction factor shall be calculated as follows.

$$F_{AZ} = H_{A/C} + B_{ANT}$$

where F_{AZ} = azimuth correction factor

$H_{A/C}$ = aircraft heading

B_{ANT} = bearing of antenna boresight

This program shall provide all conversion factors required to transform all angular data to the unit system employed by the parameter encoder.

3.3.7.3.2.2 NESU Blanking. This program shall monitor the aircraft pitch and roll altitude on each update cycle and shall disable the SS NESU whenever either of these two parameters exceeds predefined limits, MAX ROLL and MAX PITCH. The NESU shall remain disabled until the aircraft altitude returns to within the specified limits whereupon the NESU shall be reenabled.

3.3.7.3.2 Aircraft Altitude Outputs

The outputs from the aircraft altitude and altitude data distribution function are given in table 60.

3.3.8 DEVICE INTERFACE

(This section to be supplied at a later date.)

Table 60. Aircraft Altitude Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Azimuth Connection Factor	Parameter Encoder	I/O Message			100 msec	

3.3.9 NONOPERATIONAL SUPPORT PROGRAMS

3.3.9.1 Power Up Program

The power up program shall load the SC memory from a tape cassette unit, then initialize and load all other units in an ordered sequence to bring the IEWS system into a nominal operating state. The power up program shall proceed through the following four stage sequence:

1) unit standby,
2) program load,
3) data load, and
4) unit activate.

3.3.9.1.1 Power Up Program Inputs

The inputs to the power up program are given in table 61.

3.3.9.1.2 Power Up Program Processing

A power up sequence shall be initiated whenever power is applied to the SC. In addition, the program may be executed by the system operator through the control panel or by program instruction.

3.3.9.1.2.1 Unit Standby. A master clear shall be distributed to all units at the start of the power up program. This shall cause all units to enter into a standby state where they shall be receptive to SC commands. Units shall not transmit data which would require other units to respond since they may require further initialization or programming to become responsive.

3.3.9.1.2.2 Program Load. All memory within the IEWS system shall be loaded using a magnetic tape cassette unit. The SC shall initiate and control the transfer of data from the cassette unit to the SC interface memory module. From there the data shall be distributed within the SC and to other units. This stage shall include the loading of all program instructions which allow the various units to respond to normal interface commands and to transfer data.

3.3.9.1.2.3 Data Load. All data and operating constants shall be capable of being loaded independently using normal command and data transfer instructions both within the SC and between the SC and the other units comprising the IEWS system.

3.3.9.1.2.4 Unit Activate. The SC shall activate all units in an ordered sequence after both program and data loading operations have been completed. Units shall be activated in a sequence which allows the destination units to be operational at the time the source unit is activated.

3.3.9.1.3 Power Up Program Outputs

The outputs from the power up program shall be as given in table 62.

3.3.10 SYSTEM TEST

A system test shall be performed in response to a request from the system operator received through the display and control interface. This test shall consist of an end to end test which exercises the system controller, technique generator, emitter tracker, parameter encoder, signal tracker and the display and control units.

Table 61. Power Up Program Inputs

ITEM	TASK / DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Program Load	Power Up	Automatic				
2	Load Signal Sorter	Display & Control	Operator Keyboard				
3	Load Technique Generator	Display & Control	Operator Keyboard				
4	Load System Controller	Display & Control	Operator Keyboard				
5	Load Data File D, M	Display & Control	Operator Keyboard				

Table 62. Power Up Program Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Master Clear	All Units					
2	Load Data Block	Tape Cassette	I/O Command			as required	
3	Data Load	Signal Sorter & Technique Generator	Data Transfer				
4	Microprocessor Control halt start initialize single step	Signal Sorter & Technique Generator	Memory Load				

3.3.10.1 System Test Program Inputs

The inputs for the system test program are given in table 63.

3.3.10.2 System Test Program Processing

A system test mode shall be established whenever the system test bit is active. This mode shall allow normal processing to proceed except that a synthetic emitter shall be created and a special display mode shall be activated. This system test mode shall remain in effect as long as the system test bit is active. Upon transitioning to the inactive state, the synthetic emitter shall be deleted and the system shall revert back to its original state before the system test was initiated.

3.3.10.2.1 System Test Bit Active

When the system test bit transitions from inactive to active, the following sequence shall be executed:

1) initiate system test display mode, and
2) program synthetic emitter injection.

3.3.10.2.1.1 System Test Display Mode. During system test, only synthetic emitters shall be displayed. These emitters shall be recognized by their classification codes and shall be displayed using standard procedures as presented in 3.3.6. The operator will make a GO or NO/GO judgment based upon the displayed data.

The following is the normal sequence.

1) Both displays will be blanked of previous emitters and data.
2) The programmed synthetic emitter will appear on the polar display within 200 ms.
3) The injected emitter will appear on both displays within 500 ms.

The system test program shall be responsible for performing the following operations.

1) Save the current mode of the polar display.
2) Save the current mode of the alphanumeric display.
3) Change the mode of the polar display to system test.
4) Change the mode of the alphanumeric display to system test.

3.3.10.2.1.2 Synthetic Emitter Injection. The technique generator shall be programmed to inject a test signal into the multibeam receiver to simulate a synthetic emitter. This emitter shall be referred to as the injected synthetic emitter. In order to generate this signal, another synthetic emitter must be created within the emitter track files. This latter emitter shall be referred to as the generated synthetic emitter.

Table 63. System Test Program Inputs

ITEM	TASK/DATA NOMENCLATURE	SOURCE	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Initiate Test	Display & Control Program	Supervisor				

Synthetic emitters shall be created by executing the following sequence.

1) The signal sorter shall be requested to create a sorter track file (STF) using the a priori parameters.

F =	QF =
PRIA =	QPRI =
PRIB =	
PW =	QPW =
AZ =	QAZ =

2) After the SS identifies the STF number, an ETF shall be created using the same parameters. A classification code corresponding to the generated synthetic emitter will be inserted thus bypassing the normal classification sequence.

3) The priority list shall be reordered by inserting the generated synthetic emitter into priority number one position and moving all other emitters down one position in the list. The operator priority override flag shall also be set.

4) The response code (TBD) shall be inserted in the ETF and the operator technique override flag shall be set. This response code shall indirectly specify the injected emitter parameter and the requirement for an alternate tracker in the ET.

5) A normal new emitter resource management routine shall be executed as described in section 3.3.4.

6) A single synthetic PDW shall be injected into the signal sorter with the following parameters.

F	= TBD	MF	= 0
PW	= TBD	DATA	= 0A
AZ	= 00	VF	= 0
TOA	= 000FF	T	= 0
AMP	= 0A	L1	= 0
CW	= 0	L2	= 0

3.3.10.2.2 System Test Bit Inactive

When the system test bit transitions from active to inactive, the following sequence shall be executed.

1) Restore the polar and alphanumeric modes to their previous state.

2) Delete both synthetic emitter files.

3) Restore the priority list by removing the programmed emitter entry and moving all other emitters up one position.

4) Request a normal update sequence from the resource management as described in section 3.3.4.

3.3.10.3 System Test Program Outputs

The output of the system test program shall be as given in table 64.

Table 64. System Test Program Outputs

ITEM	TASK DATA NOMENCLATURE	DESTINATION	METHOD OF INSERTION	LEGALITY CHECK	QUANTITY	TIMING	COMMENTS
1	Create Track File SFN LTOA TAZ PRIA PRIB TCOPE TTAMP TDW TQPRI TQPW TQF TQAZ TF TCOUNT TPAMP	Signal Sorter	I/O Message				
2	Initiate ET Channel	Emitter Tracker	I/O Message				

3.4 ADAPTION

3.4.1 DATA BASE REQUIREMENTS

The data base shall consist of common data that is loaded during initialization. The data base shall contain parameter values, address pointers, etc. which are required during program operation. The data base shall consist of:

1) emitter library,
2) technique library,
3) resource library, and
4) option library.

3.4.1.1 Emitter Library

The emitter library (EL) shall contain data for those emitters of concern to IEWS. Each identifiable emitter or emitter mode shall have a unique library entry. Identifiable emitters shall include all emitters that may be included in an electronic order of battle (EOB) plus a number of emitter descriptors that include generic categories of emitters. The latter entries shall constitute a means of handling what has often been referred to as "unknowns," that is, if an emitter type can be described, it can be recognized and a response can be specified. The EL shall contain the following types of data:

1) discriminants,
2) classification code, and
3) response code.

The discriminants contained in the library shall be the minimum and maximum values of frequency, PRI, pulse width, and scan period and the scan type of the emitters of concern. The classification code shall contain the identification, mode, function, platform type, and generic type of each emitter of concern. The response code shall consist of a technique assignment number for each of the primary, secondary, and tertiary ECM techniques for each emitter plus provisions to specify up to four external system responses.

The emitter library shall be divided into sections corresponding to the type of emitter signal to be entered. The divisions shall be as follows:

1) pulse signals,
2) CW signals,
3) AN/ALR-50 signals, and
4) other sensor signals.

3.4.1.1.1 Pulse Emitter Library

For purposes of searching the library during the classification of pulse signals, the EL shall be further subdivided into emitter library 1 (EL1) and emitter library 2 (EL2). The contents of EL1 shall correspond to the discriminants, frequency, PRI, and pulse width, used in the level 1 search module. Entries in EL1 shall point to entries in EL2 which shall be accessed by the level 2 search module. The second library, EL2, shall contain the scan period, the scan type, the classification code, and the response code. As specified in Appendix A, the ADM library shall consist of 42 emitters of concern. When different modes of operation are taken into account, the 42 emitters shall correspond to 149 entries in EL1 and 89 entries in EL2.

3.4.1.1.1.1 Emitter Library 1. Emitter library 1 shall consist of an outer directory (OD) and a zone list section (ZLS) for each of the three parameters, frequency, PRI, and pulse width. For convenience of notation, these three parameters will be denoted as:

f = frequency,

π = PRI,

p = pulse width.

By use of the OD and the ZLS, the level 1 search module shall be capable of performing a between limits match on each of the three parameters f, π, and p. The outer directory points to a zone list which gives pointers to emitters in EL2 having values of the parameter in the zone (range) being searched. A more detailed explanation of the structure and use of EL1 is given in Appendix B.

3.4.1.1.1.1.1 Outer Directories. The outer directories for frequency (OD_f) and PRI (OD_π) shall be structurally similar. To simplify the description, the letter x will be used to denote f or π. The outer directory, OD_x, shall contain the following:

1) a number, N_x, which shall give the number of values stored in 2) and 3) for the OD_x,
2) a set (x_i) of values of the parameter x in strictly monotonically increasing order – that is, $x_i < x_i + 1$, $i = 1, 2 \ldots, N_x$,
3) a set of addresses (A_i) which shall point to keywords in ZLS_x.

The outer directory for pulse width, OD_p, shall contain only an address portion – that is, a set of addresses (A_i), $i = 1, 2, \ldots, 32$ which shall point to keywords in ZLS_p. The value of the pulse width field, PW, in the emitter track file shall point directly to the address A_i.

3.4.1.1.1.1.2 Zone List Sections. The ZLSs for f, π, and p shall be structurally similar. To simplify the description, the letter y will be used to denote f, π, or p. The zone list section, ZLS_y, shall contain a number of subsections each containing a keyword and a variable number of data words. The number of subsections for ZLS_y shall be less than or equal to N_y for the OD_y. The number of data words in each subsection shall be dependent on the contents of the keyword for that subsection. The upper limit on the number of data words for each subsection shall be 16. The data words taken together shall define a 256 component vector where each component shall correspond to an emitter entry point or trunk to EL2. A nonzero bit in a data word shall indicate that the emitter trunk corresponding to that bit points to a list of emitters in EL2 for which $y_{min} \leq y \leq y_{max}$. Since most data words will contain all zeros, the keyword shall indicate which data words are to follow. A nonzero bit in the keyboard shall indicate that the data word corresponding to that bit has one or more nonzero bits in it. The number of nonzero bits in the keyword shall equal the number of data words for that subsection. An example of a zone list subsection is given in Appendix B.

3.4.1.1.1.2 Emitter Library 2. The emitter library 2 shall be divided into two sections, one section being a directory and the second section being emitter data.

3.4.1.1.1.2.1 Directory. The directory for EL2 shall consist of a number of lists of pointers or ELNs to entries in the emitter data section of EL2. Each emitter trunk obtained from EL1 shall point to a list in the directory.

3.4.1.1.1.2.2 Emitter Data. The emitter data section of EL2 shall contain discriminant data, classification code, and response code. For each ELN, EL2 shall contain:

1) discriminant data,
   a) scan type – type of scan modulation: steady, conical, sector, circular,

b) maximum scan period – maximum time between main scan lobes,

c) minimum scan period – minimum time between main scan lobes,

2) classification code,

a) identification code – emitter code for identification,

b) mode – operating mode of emitter,

c) function – function of emitter, for example, target track, missile guidance, acquisition radar, etc.,

d) platform – type of emitter platforms: land, sea, air,

e) type – generic type: AAA, SAM, AI, etc.,

f) FA link – family association link which links all emitters of same identification together,

3) response code,

a) basic technique 1 – primary basic technique number,

b) technique data 1 – pointer to 1 of 16 test entries,

c) basic technique 2 – secondary basic technique number,

d) technique data 2 – pointer to 1 of 16 test entires,

e) basic technique 3 – tertiary basic technique number,

f) technique data 3 – pointer to 1 of 16 test entries,

g) poll period – interval for dropped track indication,

h) hit count – minimum number of pulses that must be received in a poll period before a dropped track indication is given,

i) function parameter A – mode parameter for lethality,

j) function B – altitude function for lethality,

k) function C – angle function for lethality,

l) function D – amplitude function for lethality,

m) external device pointers – indicates four subroutines to be executed to control external devices, and

n) external device data – data to be used in the indicated subroutines.

3.4.1.1.2 CW Emitter Library

The CW emitter library (CWEL) shall contain a straightforward listing of a small number of CW emitters of concern. The CWEL shall contain discriminant data, classification code, and response code. The CWEL shall be allocated a block of ELNs which shall be separate from pulse, AN/ALR-50, or other sensor entries. For each ELN in the CWEL, an entry shall contain:

1) discriminant data,

a) minimum frequency – lowest frequency value that CW signal is known to exhibit,

b) maximum frequency – highest frequency value that CW signal is known to exhibit,

2) classification code,
   a) identification code – emitter code for identification,
   b) mode – operating mode of emitter,
   c) function – function of emitter – e.g., missile guidance, acquisition, etc.
   d) platform – type of emitter platform: land, sea, air,
   e) type – generic type: AAA, SAM, etc.,
   f) FA link – family association link which links all emitters of same identification together,

3) response code,
   a) basic technique 1 – primary basic technique number,
   b) technique data 1 – pointer to 1 of 16 test entries,
   c) basic technique 2 – secondary basic technique number,
   d) technique data 2 – pointer to 1 of 16 test entries,
   e) basic technique 3 – tertiary basic technique number,
   f) technique data 3 – pointer to 1 of 16 test entries,
   g) poll period – interval for dropped track indication,
   h) function parameter A – mode parameter for lethality,
   i) function B – altitude function for lethality,
   j) function C – angle function for lethality,
   k) function D – amplitude function for lethality,
   l) external device pointers – indicates four subroutines to be executed to control external devices, and
   m) external device data – data to be used in the indicated subroutines.

3.4.1.1.3 AN/ALR-50 Emitter Library

The AN/ALR-50 EL shall contain a straightforward listing of a small number of L-band emitters of concern. The AN/ALR-50 EL shall contain only classification data. Using the AN/ALR-50, no discriminant data will be available and no response capability will be provided. The AN/ALR-50 EL entry shall be accessed by the family association link from the associated pulse signal. The AN/ALR-50 EL shall be allocated a block of ELNs which shall be separate from pulse, CW, or other sensor entries. For each ELN in the AN/ALR-50 EL, an entry shall contain the following classification code data:

1) identification code – emitter code for identification,
2) mode – operating mode of emitter,
3) function – function of emitter, for example, missile guidance,
4) platform – type of emitter platform: land, sea, air,
5) type – generic type: AAA, SAM, etc.,
6) FA link – family association link which links all emitters of same identification together.

3.4.1.1.4 Other Sensor Emitter Library

Provision shall be made to accommodate other sensor (EQ, MAWS, HARM) signals of concern in an emitter library. The method of access, structure, and content of the other sensor emitter library are TBD. This portion of the emitter library is a growth item.

3.4.1.2 Technique Library

The technique library shall contain data on techniques used in IEWS. There shall be a unique entry for each technique. The technique library shall contain the following data for each of 128 techniques:

1) special generator – which of four types of special generators are required for this technique,
2) VCO cycle time – time VCO is in use each PRI for this technique, and
3) pretrigger – emitter track pretrigger to be programmed for this technique (26/52 μs)

3.4.1.3 Resource Library

The resource library shall contain data on available external resources for IEWS responses. These data shall indicate how many of each type of emitter tracker and each type of technique generator are active and under SC control. Resource library data shall be as follows:

1) generator A – number of special generators available – type A,
2) generator B – number of special generators available – type B,
3) generator C – number of special generators available – type C,
4) generator D – number of special generators available – type D, and
5) channels – number of response channels available.

3.4.1.4 Option Library

The option library shall contain data and pointers to be used for the selection of technique options. The option library shall contain the following data for each of sixteen entries:

1) pointer – points to a subroutine for option selection,
2) PRI limits – PRI range limits (2) for option selection, and
3) frequency limits – frequency quality limits (2) for option selection.

3.4.2 INTERNAL FILES

Internal files shall consist of that data which has permanent storage allocated in the computer program but whose contents may be repeatedly changed as a result of program execution. Generally, internal files will be accessed by more than one program module. The internal files defined for this program shall be:

1) emitter track file,
2) priority file,
3) jam status file,

4) resource file,
5) D/C status file,
6) polar image file, and
7) AN image file.

3.4.2.1 Emitter Track File

The ETF shall contain emitter parameter data, file linkages, classification data, response data, display data, and control fields. There shall be an active ETF entry for each emitter or pulse train being tracked by IEWS. Provision shall be made for 256 entries in the ETF with a division of EFNs according to emitter type as given in table 65.

Table 65. EFN Assignments for the ETF

EFN	Contents
0 to 127	pulse signals
128 to 159	CW signals
160 to 191	AN/ALR-50 signals
192 to 255	other sensor signals

The contents of each section of the ETF is defined in the following paragraphs.

3.4.2.1.1 Pulse Signals

The EFN for pulse signals shall be the same as the SFN sent from the SS with the PTDW or new emitter alert. The contents of the ETF for pulse signals shall be as given in table 66.

Table 66. ETF Contents for Pulse Signals

Classification	Abbreviation	Description
emitter parameters	AZ	track azimuth from signal sorter
	AVPI	average PRI
	FREQ	average frequency
	PAMP	peak amplitude from signal sorter
	FA	frequency agile indication from signal sorter
	CW	CW indication from signal sorter (growth)
	PW	track pulse width from signal sorter
	STYP	scan type
	SPRD	scan period

Table 66. ETF Contents for Pulse Signals (cont)

Classification	Abbreviation	Description
emitter parameters (concl)	QPRI	PRI quality
	QPW	pulse width quality
	QF	frequency quality
	QAZ	azimuth quality
	LP	long pulse indication
	OFSET	synthetic offset time
	MF	multiple frequency indication
	STAG	PRI stagger level
	PRID	PRI dispersion
	FRQD	frequency dispersion
	PRIC	composite PRI
	PITYP	PRI type
	TH	throttled emitter
	RF	throttle reduction factor
file linkages	FLNK	forward azimuth link
	BLNK	backward azimuth link
	ALNK	agile link
	CLNK	correlated link
	MLNK	mode link
	PLNK	platform link
	TFN	throttle file number
classification data	ELN	emitter library number
	IDENT	identification code
response data	PTECH	primary technique number
	STECH	secondary technique number
	TTECH	tertiary technique number
	LETH	lethality
	PRSO	priority source
	ENG	emitter engaged
	VCUF	VCO utilization factor
	TESO	technique source
display data	DISP	display code
	EOCF	end-of-chain flag

Table 66. ETF Contents for Pulse Signals (concl)

Classification	Abbreviation	Description
control fields	FACT	file active
	REID	reidentification control
	UPD	update scan
	SM	scan measured
	SIND	scan state indicator

3.4.2.1.2 CW Signals

The EFN for CW signals shall be determined by the data acquisition module for CW processing. The contents of the ETF for CW signals shall be as given in table 67.

Table 67. ETF Contents for CW Signals

Classification	Abbreviation	Description
emitter parameters	AZ	azimuth from heterodyne receiver
	FREQ	frequency from heterodyne receiver
	AMP	amplitude from heterodyne receiver
file linkages	FLNK	forward azimuth link
	BLNK	backward azimuth link
classification data	ELN	emitter library number
	IDENT	identification code
response data	PTECH	primary technique number
	STECH	secondary technique number
	TTECH	tertiary technique number
	LETH	lethality
	PRSO	priority source
	ENG	emitter engaged
	VCUF	VCO utilization factor
	TESO	technique source
display data	DISP	display code
control fields	FACT	file active

3.4.2.1.3 AN/ALR-50 Signals

The EFN for AN/ALR-50 signals shall be determined by the data acquisition module for AN/ALR-50 processing. The contents of the ETF for AN/ALR-50 signals shall be as given in table 68.

Table 68. ETF Contents for AN/ALR-50 Signals

Classification	Abbreviation	Description
emitter parameters	AZ	track azimuth of associated emitter in ETF
	OFSET	synthetic offset time
file linkages	FLNK	forward azimuth link
	BLNK	backward azimuth link
	CLNK	correlated link
	PLNK	platform link
classification data	ELN	emitter library number
	IDENT	identification code
display data	DISP	display code
	EOCF	end-of-chain flag
control fields	FACT	file active

3.4.2.1.4 Other Sensor Signals

Provision shall be made to provide ETF storage for signals from other sensors. The content of the ETF for other sensor signals is TBD. This portion of the ETF is a growth item.

3.4.2.2 Priority File

The priority file shall be a list of threat ETF entries whose lethality exceeds the lethality threshold. The ordinal position of an entry in the priority file shall be its priority. The priority file shall contain the following data on 128 possible entries:

1) ETF number – address of EFT entry with this priority,
2) JSF number – address of corresponding jam status file entry, if any,
3) priority source – indicates whether priority of this entry is determined by relative lethality or operator override, and
4) active response – indicates this entry has corresponding jam status file (JSF) entry.

3.4.2.3 Jam Status File

The jam status file shall contain data on response in progress. The JSF shall contain the following data on each of eight response channels:

1) ETF number – address of ETF entry to which this channel has been assigned,
2) generator number (A) – indicates the generator number, if any, assigned a response of type A,
3) generator number (B) – indicates the generator number, if any, assigned a response of type B,

4) generator number (C) – indicates the generator number, if any, assigned a response of type C,
5) generator number (D) – indicates the generator number, if any, assigned a response of type D,
6) option number – indicates one of three technique options assigned to this channel, and
7) tracker link – indicates operation of a technique generator from an adjacent tracker (up, down, source, none).

3.4.2.4 Resource File

The resource file shall contain data on which resources are currently in use. These resources shall consist of special generators and VCO usage. The VCO usage shall be monitored by maintaining the total utilization factor and those parameters which are necessary to determine the maximum allowable total utilization factor. The resource file shall contain the following data:

1) generator A – indicates a special generator of type A is in use,
2) generator B – indicates a special generator of type B is in use,
3) generator C – indicates a special generator of type C is in use,
4) generator D – indicates a special generator of type D is in use,
5) total utilization factor – indicates the sum of the VCO utilization factors for all responses,
6) max MF – indicates the largest number of simultaneous frequencies in a single response,
7) MFs present – indicates the number of responses to more than one simultaneous frequency, and
8) CW response – indicates the presence of a CW response.

3.4.2.5 D/C Status File

The D/C status file shall contain data indicating the status of the IEWS system as it has been defined by the IEWS operator through the D/C unit. Data in this file shall indicate D/C control positions at the last control update, states of the system which may be occasionally modified by the operator, and data which is required to maintain the IEWS display.

The D/C status file shall contain the following data:

1) D/C control states – indicates the position of all D/C controls at last control update,
2) expand azimuth – azimuth requested for expand mode,
3) emitter type – emitter type requested for type mode,
4) hook ID – ETF entry requested for special action,
5) hook TF – ETF entry requested for parameter mode display,
6) page – designates eight emitters to be displayed in the list mode,
7) MG response – designates display response requested for missile guidance signals,
8) new expand – indicates update not completed since expand command,

9) new priority – indicates update not completed since priority command,
10) threat total – number of entries in priority file, and
11) last heading – airplane heading used in last polar display update.

3.4.2.6 Polar Image File

The polar image file shall contain data on the current state of the polar display. The polar image file shall contain the ETF number of the highest lethality ETF entry at each azimuth during the last polar update.

3.4.2.7 AN Image File

The AN image file shall contain data on the current state of the AN display when operating in the list mode. The AN image file shall contain the ETF number of the ETF entry whose parameters are being displayed on each line of the AN display.

3.4.3 ADAPTIVE PARAMETERS

Adaptive parameters are those operating parameters that can be modified to change the operating characteristics of IEWS. Adaptive parameters shall be modified either by the operational program, by initial program load, or by both. The parameters under program control can be categorized as follows:

1) unit control parameters, and
2) internal program parameters.

3.4.3.1 Unit Control Parameters

The unit control parameters shall be those operating parameters in units of IEWS which are capable of being modified by the SC program. The units having interfaces with the SC are:

1) multibeam receiver,
2) heterodyne receiver,
3) instantaneous frequency measurement receiver,
4) parameter encoder,
5) signal sorter,
6) emitter tracker,
7) technique generator,
8) display and control, and
9) special test equipment.

The capability of the SC to modify the operating parameters of these units is specified in the following paragraphs.

3.4.3.1.1 Multibeam Receiver Controllable Parameters

The SC program shall be capable of modifying the system threshold in the multibeam receiver in 5 dB steps over a range of 40 dB.

3.4.3.1.2 Heterodyne Receiver Controllable Parameters

The SC program shall be capable of modifying the operation of the heterodyne receiver by controlling the following parameters:

1) dwell time – total time spent in search mode for specified frequency band: variable from 1 μs to 1 ms in 1 μs steps,
2) frequency limits – frequency limits of band being searched: 0 to 2 GHz in 5 MHz steps, and
3) enable/disable – enable or disable the operation of the heterodyne receiver.

3.4.3.1.3 Instantaneous Frequency Measurement Receiver Controllable Parameters

There shall be no requirement for the SC program to control or modify the operation of the instantaneous frequency measurement receiver.

3.4.3.1.4 Parameter Encoder Controllable Parameters

The SC program shall be capable of modifying the operation of the parameter encoder by controlling the following parameters:

1) threshold – amplitude encoding threshold above which pulse data shall be encoded: 0 to 51 dB in 1.6 dB steps, and
2) long pulse mode – controls method of encoding long pulses: mode 1 will encode a single pulse with PW > 3.6 μs; mode 2 will encode pulses at 4 μs increments up to 16 pulses, or end of pulse whichever occurs first.

3.4.3.1.5 Signal Sorter Controllable Parameters

The SC program shall be capable of modifying the operation of the signal sorter by controlling the following parameters:

1) sorter start – transfer sorter from idle loop to sort mode,
2) sorter pause – sorter is placed in an idle loop where it will only respond to low priority messages,
3) initialize sorter – sets initial parameter values and enters idle loop,
4) initialize/start – clears CAM files and starts search for new emitters,
5) pause NESU – places NESU in idle loop,
6) start/stop UPDWs – starts and stops transfer of UPDWs over auxiliary bus,
7) start/stop SPDWs – starts and stops transfer of SPDWs over auxiliary bus,
8) update time – changes sorter track file update time to 1, 2, or 4 μs,
9) purge time – time interval after which inactive sorter track file is declared if no PDWs were received: variable, 50 ms to 204.8 s in 50 ms steps,

10) reset inactive file alert – reenables inactive file alert after one alert has already been sent,

11) NESU threshold – changes number of PDWs needed to establish non-frequency-agile track file: variable 1 to 256 in unit steps,

12) quality bit modify – modifies weighting factors for sorting on PRI, pulse width, frequency, or azimuth: variable 1 to 16 in unit steps,

13) aux bus amplitude threshold – changes amplitude level above which PDWs will be transferred on auxiliary bus: variable 0 to 60.8 dB in 3.2 dB steps,

14) delete track file – clears specified track file: any file 0 to 127,

15) modify throttle file – creates a throttle file at specified azimuth and frequency with specified reduction factor: azimuth resolution = 1 cell, frequency resolution = 10 MHz, reduction factor variable, 0 to 256 in steps of 16,

16) azimuth count – changes number of PDWs needed to establish an angle track file: variable 1 to 256 in unit steps,

17) create track file – creates a sorter track file for specified azimuth, PRI, pulse width, and frequency with specified quality factors: resolution and range as specified for each parameter in, and

18) modify address – allows SC to change instructions or data in sorter memory.

3.4.3.1.6 Emitter Tracker Controllable Parameter

The SC program shall be capable of modifying the operation of the emitter tracker by controlling the tracker links which causes one of the ET outputs to be that of an adjacent response channel.

3.4.3.1.7 Techniques Generator Controllable Parameter

The SC program shall be capable of modifying the operation of the techniques generator by controlling the override frequency which causes the technique generator to operate on a fixed radio frequency for a given channel.

3.4.3.1.8 Display and Control Parameters

The basic operation of the display and control shall not be modified by the SC program.

3.4.3.1.9 Special Test Equipment Parameters

There is no requirement for the SC program to control the operation of the special test equipment during normal operation. However, the SC program shall be capable of controlling the operation of the cassette tape unit during program loading as follows:

1) start – start tape from the present position,
2) stop – stop tape,
3) rewind – rewind tape to load point,
4) skip forward – skip one file forward, and
5) skip back – skip one file backward.

3.4.3.2 Internal Program Parameters

The internal program parameters shall be those operating parameters in the programs specified herein which affect the performance of the overall system operation. The program modules that may have internal program parameters will be:

1) executive,
2) data acquisition,
3) emitter classification,
4) resource management,
5) PDW processing,
6) display and control, and
7) system management.

Descriptions of these parameters are given in the following paragraphs.

3.4.3.2.1 Executive

The executive shall have no internal program parameters that affect the operating characteristics of the system.

3.4.3.2.2 Data Acquisition

The internal program parameters in the data acquisition module which affect its operation shall be:

1) subharmonic constant, ϵ,
2) pulse update limits, and
3) CW frequency limit.

3.4.3.2.2.1 Subharmonic Constant. The subharmonic constant, ϵ, is defined in 3.3.2.1.2.1.4 and shall be the limit within which the subharmonics of two pulse trains must agree to be considered subharmonically related.

3.4.3.2.2.2 Pulse Update Limits. The pulse update limits are defined in 3.3.2.1.2.2 and shall be the limits within which the pulse update parameters for a none-of-the-above (NOFA) emitter must agree with the stored values in order to avoid being reclassified.

3.4.3.2.2.3 CW Frequency Limit. The CW frequency limit, K_{CW}, is defined in 3.3.2.2.2.1 and shall be the limit within which a received CW signal must agree with an established track file entry in order to update that entry.

3.4.3.2.3 Emitter Classification

The internal program parameters in the emitter classification module which affect its operation shall be:

1) amplitude threshold, A_T,
2) subharmonic constant, ϵ,
3) coincidence threshold, K, and
4) number of mode cycles, N.

3.4.3.2.3.1 Amplitude Threshold. The amplitude threshold, A_T, is defined in 3.3.3.2.2 and shall be the threshold for an emitter above which the value of PAMP shall be in order to request a scan analysis for that emitter.

3.4.3.2.3.2 Subharmonic Constant. The subharmonic constant, ϵ, is defined in 3.3.3.3.2.3.1 and shall be the limit within which the subharmonics of two pulse trains must agree to be considered subharmonically related.

3.4.3.2.3.3 Coincidence Threshold. The coincidence threshold, K, is defined in 3.3.3.3.2.3.1 and shall be the value within which the PDW count for a group of multiple frequency emitters must agree with the expected number of PDWs in order to be classified as coincident.

3.4.3.2.3.4 Number of Mode Cycles. The number of mode cycles, N, is defined in 3.3.3.3.2.4.1 and shall be the maximum of times that mode groups will be tested for exclusive sets of entries.

3.4.3.2.4 Resource Management

The internal program parameters in the resource management module which affect its operation shall be:

1) lethality functions,
2) lethality threshold, and
3) max utilization factor table.

3.4.3.2.4.1 Lethality Functions. The lethality functions (F_i, G_i, i = 0, 1, . . . , 15) are defined in 3.3.4.1.2.1 and shall be functions of altitude, emitter bearing, and emitter max amplitude, respectively.

3.4.3.2.4.2 Lethality Threshold. The lethality threshold, T, is defined in 3.3.4.1.2.1 and in the minimum computed lethality an emitter may have in order to be considered a threat.

3.4.3.2.4.3 Max Utilization Factor. The max utilization factor table is defined in 3.3.4.2.2.1 and gives the highest allowable total utilization factor.

3.4.3.2.5 PDW Processing

The PDW processing shall consist of the following separate program modules:

1) ABI management,
2) scan analysis,
3) frequency analysis,
4) PRI analysis,
5) contemporaneous analysis, and
6) deinterleaving.

The internal program parameters for each of these modules are specified in the following paragraphs.

3.4.3.2.5.1 ABI Management. The internal program parameters in the ABI management module which affect its operation shall be:

1) unsorted buffers, N_B,
2) scan time-out, S_A,
3) frequency buffers, F_A,

4) PRI buffers, P_A, and
5) contemporaneous time-out, C_A.

3.4.3.2.5.1.1 Unsorted Buffers. The number of buffers, N_B, for unsorted PDWs is defined in 3.3.5.1.2 and shall be the number of 64 word buffers that shall be assigned to the storage of unsorted PDWs.

3.4.3.2.5.1.2 Scan Time-Out. The scan time-out, S_A, is defined in 3.3.5.1.2 and shall be the time interval used to acquire SPDWs for scan analysis.

3.4.3.2.5.1.3 Frequency Buffers. The number of frequency buffers, F_A, is defined in 3.3.5.1.2 and shall be the number of 64 word buffers which shall be assigned to the storage of SPDWs for frequency analysis.

3.4.3.2.5.1.4 PRI Buffers. The number of PRI buffers, P_A, is defined in 3.3.5.1.2 and shall be the number of 64 word buffers which shall be assigned to the storage of SPDWs for PRI analysis.

3.4.3.2.5.1.5 Contemporaneous Time-Out. The contemporaneous time-out, C_A, is defined in 3.3.5.1.2 and shall be the time interval used to acquire SPDWs for contemporaneous analysis.

3.4.3.2.5.2 Scan Analysis. The internal program parameters in the scan analysis module which affect its operation shall be:

1) amplitude threshold, A_T,
2) scan decision boundary, K_1 and K_2.

3.4.3.2.5.2.1 Amplitude Threshold. The amplitude threshold, A_T, is defined in 3.3.5.2.2 and shall be the amplitude value below which it is assumed that a sidelobe data sample has been received. The value of A_T used in scan analysis shall be the same as that value of A_T specified in 3.3.3.2.2 and 3.4.3.2.3.1.

3.4.3.2.5.2.2 Scan Decision Boundaries. The scan decision boundaries K_1 and K_2 are defined in 3.3.5.2.2 and shall be decision values for the test statistic, t_s, which shall determine whether the scan is steady, conical, or sector. The decision rule shall be:

if $0 \leq t_s \leq K$, conclude steady scan,

if $K_1 < t_s \leq K_2$, conclude conical scan, or

if $K_2 < t_s < \infty$, conclude sector scan

3.4.3.2.5.3 Frequency Analysis. There shall be no internal program parameters for the ADM version of the frequency analysis module.

3.4.3.2.5.4 PRI Analysis. The internal program parameter for the PRI analysis module is the stable threshold, K_S, defined in 3.3.5.4.2. The stable threshold shall be the maximum value of the variance of the PRI value for which no further analysis shall be required to conclude a stable PRI.

3.4.3.2.5.5 Contemporaneous Analysis. The internal program parameter for the contemporaneous analysis module is the PDW count threshold, K_c, defined in 3.3.5.2.2. The PDW count threshold shall be the minimum number of PDWs that must be received in a data acquisition interval in order to conclude that a sorter track file entry was active in the interval.

3.4.3.2.5.6 Deinterleaving. There shall be no internal program parameters for the ADM version of the deinterleaving module.

3.4.3.2.6 Display and Control

The internal parameter in the display and control module which affect its operation shall be the lethality limits.

3.4.3.2.6.1 Lethality Limits. The lethality limits, L_1, L_2, L_3, L_4 and L_5, are defined in 3.3.6.2.2.1 and determine the lethality range for each vector length on the polar display.

3.4.3.2.7 System Management

Internal program parameters used by the system management programs shall be:

1) roll limit, R_{max}, and
2) pitch limit, P_{max}.

3.4.3.2.7.1 Roll Limit. The roll limit, R_{max}, is the maximum permissible aircraft roll before the SS NESU is blanked.

3.4.3.2.7.2 Pitch Limit. The pitch limit, P_{max}, is the maximum permissible aircraft pitch before the SS NESU is blanked.

3.4.4 PROGRAM PERFORMANCE AND CAPABILITY REQUIREMENTS

This section defines general performance requirements and file size limitations that shall be used as design guidelines during the development of this computer program.

3.4.4.1 Emitter Track Files

The emitter track files shall be designed in a modular fashion so as to facilitate expansion as required to meet future operational requirements. These requirements are expected to be in excess of 400 track files. This computer program shall be designed to accommodate 191 emitter track files as shown in table 69.

Table 69. Emitter Track File Requirements

File Address	Signal Type
0 to 127	pulse
128 to 159	AN/ALR-50
158 to 191	CW

3.4.4.2 Emitter Library

The emitter library shall be designed in a modular fashion so as to facilitate expansion to meet future operational requirements. These exact requirements are strongly dependent on operational locale and emitter types, but may well exceed several hundred entries. This computer program shall provide a library which characterizes 42 emitter types as specified by Appendix A. The development of any emitter library shall be included as part of an operational support program.

3.4.4.3 Emitter Evaluation Rates

The system controller shall be designed with the capability of responding to the expected data rate produced by the SS in any operational environment. For this program, maximum rates shall be exclusively determined by the new emitter alert and emitter update rates. These rates are random in nature; however, the system controller shall process a sustained average rate of one new emitter per second and shall update 20 emitters per second.

3.4.4.4 System Response Capability

The system controller has been designed to allow expansion of response capability both in the number of emitters handled by each unit and in the number of external units controlled. This computer has been designed to program the IEWS technique generator plus four external systems, HARM, AN/ALE-39, MAWS, and EO.

The technique generator shall be programmed using the optimization program specified in 3.3.4.3, resource assessment, to establish and maintain response against up to 20 emitters.

Programs will not be developed during the ADM design which would control the external system. Provisions shall be included in the response code portion of the emitter library to designate external system response. This code shall provide for 16 options for each of four external systems.

3.4.4.5 Operator Display Stations

One operator display station is provided in the IEWS system. This station contains two display devices as well as several indicators and operator controls. In addition, the system controller is provided with control panels for each of the three internal processors for use during maintenance procedures. The maintenance control panels will not be installed during normal system operation.

3.4.5 COMPUTER MEMORY REQUIREMENTS

Estimates of memory requirements for implementing this computer program within the system controller are shown in table 70. Memory requirements are broken out by function and identify both program and data requirements as well as the distribution among the three processors. The data distribution figures are associated with the processor where program execution occurs or which accesses the data.

Table 70. System Controller Program Memory Requirements

Function	Code	Data	Total Memory	Classification Processor	Response Processor	Auxiliary Processor
Response Assessment						
emitter file mgt and data acq	1150	2300	3450	3450	–	–
emitter classification	1225	2075	3300	3300	–	–
response assessment	1200	1775	2975	–	2975	–
resource allocation	1350	2575	3925	–	2925	–
Auxiliary PDW Processing						
PDW acquisition	1250	1025	2275	–	–	2275
scan analysis	1450	775	2225	–	–	2225
PRI analysis	1400	775	2175	–	–	2175
frequency analysis	800	775	1575	–	–	1575
correlation analysis	1000	775	1775	–	–	1775
Display	3200	1025	4225	2375	1850	–
System Mgt	1450	500	1950	1325	625	–
Executive	1675	250	1925	750	750	425
Instrumentation	500	500	1000	250	750	–
Total	17650	15125	32775	11450	10875	10450

SECTION IV
QUALITY ASSURANCE

4.1 INTRODUCTION

The computer program implemented within the system controller shall be tested in four phases:

1) development testing,
2) unit acceptance testing,
3) integration testing, and
4) system performance testing.

Development tests, unit acceptance tests, and integration tests shall be required to demonstrate compliahce with CPDS design and performance requirements. System performance testing shall be required to demonstrate compliance with system requirements. The latter test only shall be required as a contractual item. The former items shall be required to satisfy program management requirements.

4.2 TEST REQUIREMENTS

The level of testing shall be as specified in this section for the four test phases identified in 4.1.

4.2.1 DEVELOPMENT TESTS

Development tests shall include all tests necessary to develop computer code to realize the requirements specified herein. These tests shall consist of the following levels:

1) module tests,
2) function tests, and
3) integration tests.

Program modules shall comprise the smallest functional building blocks in the program and shall be defined as part of the Computer Program Design Document. All modules shall be tested to verify that they meet the requirements specified in the CPDS.

Program modules shall be assembled into complete functional programs corresponding to the major sections within this specification. Functional test programs shall demonstrate that these functional programs meet the requirements of this specification. The major functional programs shall consist of the following items:

1) executive,
2) ETF management and data acquisition,
3) emitter classification,
4) resource management,
5) PDW processing,
6) display and control,
7) system management,
8) device interface,

9) nonoperational support, and
10) built in test.

Integration tests shall be designed to demonstrate compatibility of functional program interfaces. Generally, these tests shall be designed to test the internal processor to processor communication, data transfer and control mechanisms and conventions.

These tests shall be performed using the facilities of the program generation center (PGC) and the software development center (SDC).

4.2.2 UNIT ACCEPTANCE TESTS

A unit acceptance test shall be conducted using the final operational computer program loaded into the system controller unit. Tests will be controlled and data extracted, processed and presented for evaluation using the STE configured as a system controller unit tester. These tests shall be designed to demonstrate that the computer program meets the requirements of this specification. These tests shall be of a logical nature only and are not intended to test dynamic environments involving interrelated time varying events.

4.2.3 SYSTEM INTEGRATION TESTING

System integration tests shall be used to integrate a tested system controller into the overall IEWS system and shall consist of three levels:

1) interface hardware tests,
2) interface logic tests, and
3) performance tests.

Hardware interface tests shall be defined which verify the operation of unit interfaces. These tests shall demonstrate that data transfer occurs as specified.

Logical interface tests shall be defined which demonstrate the message formats, and the command and control features specified at each interface. These tests shall be limited to the verification of unit response to message inputs except that unit responses may be specified as part of a message transfer.

Performance tests shall be designed to demonstrate compliance with system level requirements as specified in XAV-1000. These tests shall include both static and dynamic stimulus which are grouped into the following categories:

1) response to various emitter types,
2) response in multiple signal environments, and
3) response to operator commands.

APPENDIX A
IEWS SIGNAL CLASSIFICATION STUDY

A.1 INTRODUCTION

The IEWS Signal Classification Study is a classified document. It is identified as IEWS No. 360, by R. Vivian, dated 30 April 1976, Raytheon ESD DCC No. 760844 (Secret).

APPENDIX B
EMITTER LIBRARY 1

B.1 INTRODUCTION

Emitter library 1 (EL1) consists of an outer directory (OD) and a zone list section (ZLS) for each of the three parameters: frequency (f), PRI (π), and pulse width (p). These six entities are shown in figure B-1 and described below.

B.2 OUTER DIRECTORIES

B.2.1 OD_f AND OD_π

These two directories are structurally similar; therefore, the following descriptions will use the letter x as a generic substitute for f or π.

The OD_X consists of two columns of length N_X with the value of N_X itself stored immediately before the first column. The first column is named ODV_X and contains values of parameter x while the second column is named ODA_X and contains addresses of keywords of the ZLS_X subsections.

The values x_1 stored in ODV_X are ordered

$$x_1 < x_2 < \ldots < x_{n_{X-1}} < x_{n_X}.$$

Each x_i, $i \doteq 1, 2, \ldots N_X$ defines a left-closed, right-open interval $[x_i, x_{i+1})$ or a completely closed interval $[X_i, X_{i+1} - g]$ where g = granularily of parameter x.

The addresses $A_i \neq 0$ in ODA_X point to keywords in ZLS_X. A keyword and its data words constituting a ZLS subsection denote a list of emitters.

The overall connection among ODV_X, ODA_X and ZLS_X is:

Given $\hat{x}$ a sample value of parameter x.

Suppose that $x_i \leq \hat{x} < x_{i+1}$

and that $A_i \neq 0$.

Then $A_i \longrightarrow$ list of all emitters such that their (two-sigma) range of parameter x wholly covers $[x_i, x_{i+1})$,

that is, this list can be written as

$E_i(\hat{x}) = E_i = \left\{ e_k \mid x_i \leq x(e_k) < x_{i+1} \right\}$ is the list of all x-matching emitters.

Figure B-2 illustrates the connection between an emitter/parameter-range diagram and the corresponding OD and ZLS.

B.2.2 OD_p

This outer directory differs from OD_f and OD_π by having only an address portion ODA_p and no value portion ODV_p. This is because the PW parameter, p, received in the EDW is not a PW value, but a 5-bit binary code for a set of PW ranges already determined in the signal sorter. This 5-bit code immediately indexes ODA_p.

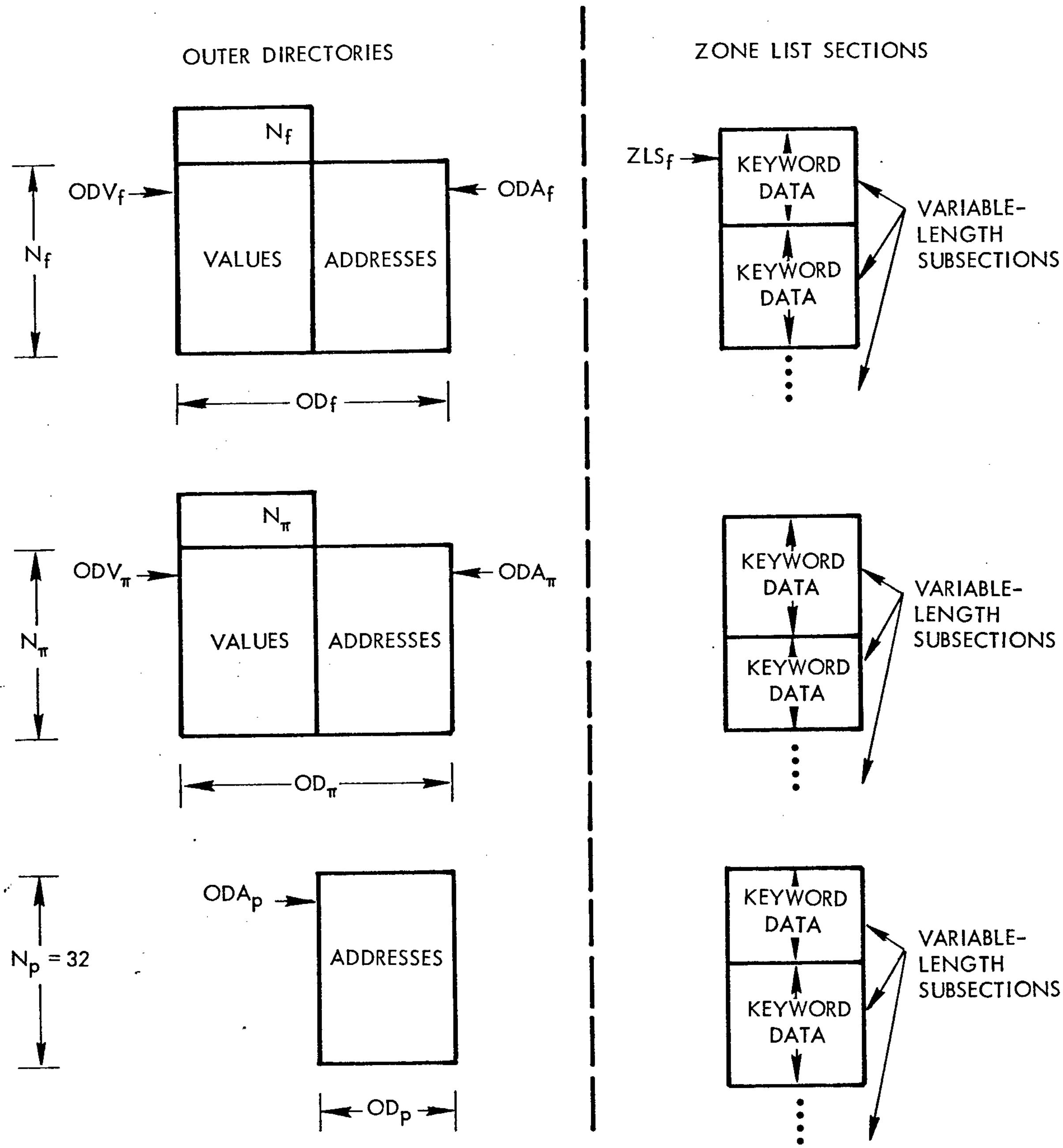
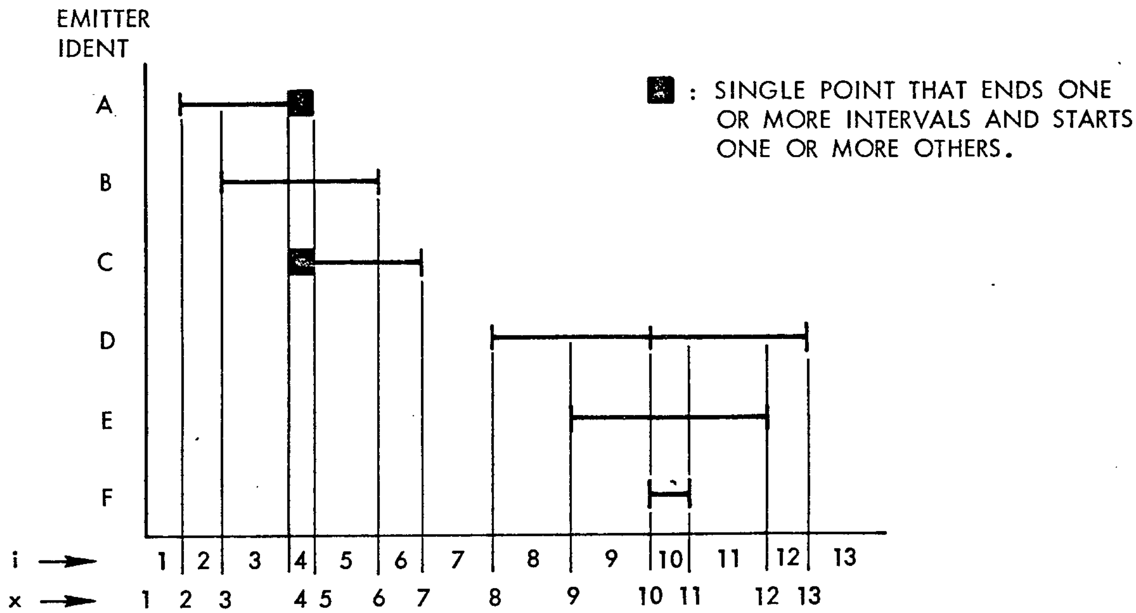


Figure B-1. Structure of Emitter Library 1



i	ODV	ODA	ZLS
1	x_1	$A_1 = 0$	<EMPTY>
2	x_2	A_2 →	A
3	x_3	A_3 →	A B
4	x_4	A_4 →	A B C
5	$x_5 = x_4$ + GRANULARITY	A_5 →	B C
6	x_6	A_6 →	C
7	x_7	$A_7 = 0$	<EMPTY>
8	x_8	A_8 →	D
9	x_9	A_9 →	D E
10	x_{10}	A_{10} →	D E F
11	x_{11}	A_{11}	
12	x_{12}	A_{12}	
13	x_{13}	$A_{13} = 0$	<EMPTY>

NOTES:

1) A VALUE OF $A_i = 0$ INDICATES THAT NO EMITTER HAS A VALUE OF PARAMETER x IN THE RANGE (x_i, x_{i+1}).

2) THE FIRST AND LAST VALUES OF x ARE CHOSEN SO THAT THEY ARE SMALLER AND LARGER RESPECTIVELY THAN ANY LEGITIMATE VALUE OF PARAMETER x. THE CORRESPONDING As ARE EQUAL TO 0.

3) WHEN $E_i = E_j \neq$ EMPTY FOR SOME $i \neq j$, THEN ZLS SPACE IS SAVED BY SETTING $A_i = A_j \neq 0$.

Figure B-2. Relationship of ODV, ODA and ZLS

B.3 ZONE LIST SECTIONS

The meaning and function of the ZLS and its relation to ODV and ODA are described in B.2.1. This section describes the detailed inner structure of a ZLS subsection, that is, the manner in which a ZLS subsection represents an emitter list.

All three ZLSs (ZLS_f, ZLS_π and ZLS_p) are structurally similar so that it is possible to unify their descriptions using the letter y as a generic substitute for f, π, and p.

Each ZLS_y consists of one or more subsections. Each subsection is essentially a binary bit vector with the bits numbered one to the value of N_E that is equal to the number of emitter trunks that are unique within f_{min}, f_{max}, π_{min}, π_{max}, p_{min}, p_{max}. The present limitation is $N_E \leq 256$.

If a bit in such a vector is equal to one, the emitter corresponding to the number of the bit is on the candidate list for the y-zone whose ODA_y entry points to the subsection. Since most binary bit entries will be equal to zero, all 16-bit words from the subsection which are all zeros are omitted, and a keyword is provided indicating which nonzero words are present.

For example, suppose that the emitter list for some zone consists of emitters numbered 1 and 144. Then the ZLS subsection shall be three words long as follows:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit No.
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	Keyword
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Word No. 1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Word No. 9

In this example, the keyword indicates that words no. 1 and no. 9 are nonzero (and follow), while words no. 2 to 8 and 10 to 16 are all zero (and absent). Bit 15 of word no. 1 corresponds to emitter no. 1, and bit 0 of word no. 9 corresponds to emitter no. 144.

APPENDIX C
LIST OF ABBREVIATIONS

ABI	auxiliary bus interface
ADM	advanced development model
AN	alphanumeric
AR	ambiguity resolution
CA	contemporaneous analysis
CL	correlation analysis
CPU	central processor unit
CW	continuous wave
CWDW	CW data word
D/C	display and control
DMA	direct memory access
ECM	electronic countermeasures
EDM	engineering development model
EDW	emitter descriptor word
EFN	emitter track file number
EL	emitter library
ELN	emitter library number
EO	electro-optical
EOB	electronic order of battle
ERP	effective radiated power
ET	emitter tracker
ETF	emitter track file
FA	family association
FIFO	first in first out
FLIH	first level interrupt handler
HARM	homing anti-radiation missile
HR	heterodyne receiver
I/O	input/output
IDENT	identification
IE	input emitter
IEWS	Integrated Electronic Warfare System
IFMR	instantaneous frequency measurement receiver
IH	interrupt handler
KB	keyboard
LIFO	last in first out
LPM	long pulse mode

MA	missile activity
MBR	multibeam receiver
MBT	multibeam transmitter
MF	multifrequency
MFF	multifrequency flag
MSB	most significant bit
NESU	new emitter search unit
NOFA	none of the above (emitter of no concern)
NOFA1	none of the above, level 1
NOFA2	none of the above, level 2
OD	outer directory
PA	PRI analysis
PAMP	peak amplitude
PDM	pulse delay module
PDW	pulse descriptor word
PE	parameter encoder
PGC	program generation center
PRF	pulse repetition frequency
PRI	pulse repetition interval
PTDW	pulse train descriptor word
PTS	pulse train separator
PW	pulse width
RAM	random access memory
SA	scan analysis
SC	system controller
SDC	software development center
SFN	sorter track file number
SLIH	second level interrupt handler
SPDW	selected pulse descriptor word
SS	signal sorter
SST	signal sorter tracker
STE	system test equipment
TA	throttle alert
TBD	to be determined
TG	technique generator
TOA	time of arrival
UPDW	unassociated pulse descriptor word
VCO	voltage controlled oscillator
ZLS	zone list section